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SHOT SMALL BOY

PROJECT OFFICERS REPORT—PROJECT 1.6

SOILS SURVEY (U)

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AS AD

T. B. Goode, Project Officer

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U.S. Army Engineer
Waterways Experiment Station
Vicksburg, Mississippi

Issuance Date: October [illegible], 1963

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ABSTRACT

A soils survey was conducted in Frenchman Flat at the Nevada Test Site for the Small Boy Event to provide instrumentation holes and data on the physical characteristics of the subsurface soils and backfill materials for Program 1 and Program 3 projects.

Field and laboratory tests were conducted to determine the water content, gradation, density, and strength of the natural soils and the water content and density of compacted soils used for backfilling.

Drilling and testing procedures used in conducting the survey and the results obtained are presented in this report.

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CHAPTER 1

INTRODUCTION

1.1 OBJECTIVES

The overall objectives of Project 1.8, Soils Survey, were to: (1) obtain preshot data on the character and certain physical properties of the natural soil to a depth of 375 feet in the vicinity of ground zero for the Small Boy Event in the Frenchman Flat (FF) area at the Nevada Test Site (NTS), (2) provide holes for the installation of instruments and sand columns, (3) determine density and water content of the backfill placed around structures and in instrument installations, and (4) obtain postshot data on certain physical properties of the natural soil to a depth of 75 feet. These activities were to support agencies participating in Projects 1.2, 1.3, 1.9, 3.1, 3.2, and 3.3 in analyzing blast effects as related to structures, elastic foundation deformations, permanent foundation deformations, vertical and horizontal shock wave measurements in foundation soils in the blast area, and the shielding effect of earth cover over structures.

Specific objectives of the soils survey were to (1) provide 1-1/2-inch-, 3-1/2-inch-, 6-inch-, and 7-7/8-inch-diameter holes ranging from 5 to 120 feet

deep for instrument and sand column installations for Projects 1.2, 1.3, 1.9, and 3.2; (2) make preshot determinations of stratification type, moisture content, density, strength, and compressibility of the in-situ soil to a maximum depth of 375 feet for Projects 1.2, 1.3, and 3.2; (3) determine as-placed density and water content of silt backfill placed in large-diameter instrumented holes and around structures for Projects 1.3 and 3.2; (4) determine as-placed density and water content of sand backfill around structures for Projects 3.1 and 3.3; and (5) make postshot determinations of moisture content, density, strength, and compressibility of the in-situ soil to a depth of 30 feet for Project 1.3.

The specific objectives were accomplished by: (1) drilling holes by rotary drilling methods for the installation of instruments and sand columns; (2) obtaining undisturbed and remolded samples of the in-situ soil from borings and pits, and testing the samples in the laboratory and in the field; (3) performing penetration and plate bearing tests in the field on the in-situ soils; and (4) performing water content and density tests during the placement of backfill.

1.2 BACKGROUND

Representatives of all agencies participating in the

projects were contacted to establish specific soils survey requirements and to determine optimum methods for drilling, sampling, and testing the soils.

1.2.1 Correspondence and Conferences. The soils program conducted by the U. S. Army Engineer Waterways Experiment Station (WES) was initiated and formulated through the following letters and conferences: (1) Disposition Form, dated 22 September 1961, subject "Weapons Effects Participation in Future U. S. Nuclear Tests (U)," from Office, Chief of Research and Development to Office, Chief of Engineers (OCE), ATTN: ENGRD-SE, Washington, D. C.; (2) letter dated 11 October 1961, subject "Department of Defense Schedule NOUGAT Series (U)," from DASA, FC, Albuquerque, New Mexico to the Director, WES, Vicksburg, Mississippi; (3) letter dated 20 October 1961, subject "Weapons Effects Participation in Future U. S. Nuclear Tests (U)," from the Director, WES, to OCE, ATTN: ENGRD-SE, Washington, D. C.; (4) letter dated 27 October 1961, subject "Project Proposals for Future Weapons Tests (U)," from the Director, WES, Vicksburg, Mississippi, to OCE, ATTN: ENGRD-SE, Washington, D. C.; (5) DASA planning conference, 26-27 October 1961 at DASA Headquarters, Washington, D. C.; (6) Project SMALL BOY Meeting, 4-5 January 1962 at WES; and (7) informal conferences at WES

with Program Directors and Project Officers before and during construction to determine the soils survey requirements of each project and to arrange schedules, methods, and procedures to accomplish the requirements of each project on schedule.

<u>1.2.2 Projects and Requirements.</u> A summary of projects and agencies and their requirements involving soil-survey support is given in Table 1.1. The installations involved fall into these groups: (1) shafts or holes, instrumented and backfilled; (2) wall footing and interior footing structures; (3) buried models of concrete arch and dome structures; and (4) buried models of steel arch structures.

The borings, sampling, and testing accomplished to fulfill the soils survey requirements of the projects listed in Table 1.1 are summarized in Table 1.2.

<u>1.2.3 Soils Survey Plan.</u> Considerable soils data were available on the characteristics of the subsurface soil at FF from the soils survey conducted by WES during the period May through October 1957 for Shot Priscilla of Operation Plumbbob. The ground zero of Shot Small [illegible] was about 2,500 feet NE of Shot Priscilla ground zero and was in the same general type of soil formation.

The Operation Plumbbob Soils Survey had established that: (1) the FF area is a dry lake bed (playa) located in an intermontane basin with a closed outlet and is smooth and flat over an area of approximately 8 square miles; (2) the playa soil in FF is a fairly uniform silt formation extending below a depth of 200 feet; (3) the in situ dry density of the soil varied from 65 to 101 lb/cu ft; (4) the water content of the soil varied from 10 to 21 percent; (5) the modulus of deformation was generally about 6,500 psi for the in-situ soil and about the same value for the soil compacted at a water content 3 percent dry of optimum, using standard Proctor effort. These soil data were adequate for the initial soil data requirements of all Small Boy projects.

Since specific soil test data were required for Small Boy Programs 1 and 3 at or near the various project installations before, during, and after construction of project installations, the Project 1.8 soils survey was divided into three phases: preliminary, installation, and posttest.

Preliminary phase. During the preliminary phase, prior to construction, subsurface soil explorations were made for Projects 1.2, 1.3, and 3.2 by means of split spoon tests, undisturbed sample borings, and static plate bearing tests.

The split spoon borings provided penetration resistance data on the in-place soils and disturbed samples for visual classification, laboratory classification, and water content determinations. The undisturbed sample borings provided samples for visual classification, laboratory classification tests, water content and density determinations, consolidation tests, and triaxial compression tests. The load bearing tests provided static load-bearing data on the undisturbed in-situ soil. Density and water content samples of the in-situ soil were obtained adjacent to the bearing plate before each bearing test was performed. Field operations for the preliminary phase were initiated on 23 February 1962 and completed on 13 June 1962; laboratory tests for the preliminary phase were completed on 12 October 1962.

Installation phase. During the installation phase, density and water content determinations were made in the field on compacted backfill during backfilling operations for Projects 1.3, 3.1, 3.2, and 3.3, and holes for the installation of instruments and sand columns were drilled for Projects 1.2, 1.3, 1.9, and 3.2. Field operations on the installation phase were initiated on 26 February 1962 and completed on 5 July 1962.

Posttest phase. Undisturbed sample borings were [illegible] subsequent to the shot for Project 1.[illegible]. Tests on the

samples obtained from these borings provided data on the in-situ soil characteristics after the shot for comparison with the in-situ soil characteristics before the shot. Field operations on the posttest phase were initiated on 27 November 1962 and completed on 4 February 1963; laboratory tests were completed on 1 April 1963.

The location of all borings and field tests for installations and structures where soils survey support was furnished are shown in Figure 1.1.

TABLE 1.1 PROJECTS, AGENCIES, AND REQUIREMENTS

Project	Agency	Requirements: Description	Requirements: Station
1.2	SRI	5 holes, 7-7/8-in.-diameter, 100 ft to 375 ft deep, instrumented and backfilled	505.01 to 505.06
		3 holes, 6-in. diameter, 5 ft deep, instrumented and backfilled	
		1 hole, 3-1/2-in. diameter, 120 ft deep	
		1 shaft and tunnel, excavated, 110 ft deep	
1.3	AFSWC	8 holes, 7-7/8-in. diameter, 30 ft deep, with 4 instrumented and backfilled and 4 backfilled only	503.01 to 503.12
		3 holes, 7-7/8-in. diameter, 50 ft deep, instrumented and backfilled	
		1 hole, 7-7/8-in. diameter, 20 ft deep, backfilled only	
		2 holes, 7-7/8-in. diameter, 75 ft deep, left open for posttest instrumentation	
		2 holes, 3 ft diameter, 30 ft deep, instrumented and backfilled	
1.[illegible]	WES	18 holes, 7-7/8-in. diameter, 10 to 41 ft deep, backfilled with colored sand	None
3.1	MIT	28 models of concrete arch and dome structures installed below ground surface, backfilled with sand	514.01 to 514.08
3.2	WES	1 concrete structure on steel footings, 9.5 ft below ground surface, with 88 holes, 1-1/2-in. diameter, 4 to 16 ft deep, in vicinity of the footings, backfilled with colored sand	515.01
		1 steel structure on steel and concrete footings, 10.4 ft below ground surface with 62 holes, 1-1/2-in. diameter, 2.5 to 5 ft deep, in vicinity of the footings, backfilled with colored sand	515.02
3.3	USNCEL	6 models of steel arch structures installed below ground surface, backfilled with sand	516.01 to 516.04

TABLE 1.2 SUMMARY OF SOIL BORINGS, SAMPLING, AND TESTING

Project	Phase	Field Sampling and In Situ Testing	Field Laboratory Testing	WES Laboratory Testing
1.2	Preliminary	5 borings, 7-7/8-in.-diameter from 100 to 375 ft deep: undisturbed	75 classification 71 water content determinations	19 density and water content determinations 9 consolidation at natural water content 10 triaxial, UU(Q), multiple stage
		1 boring, [illegible]-1/2-in.-diameter, 1[illegible] ft deep: general samples	Visual classifications	None required
		3 borings, 6-in.-diameter, [illegible] ft deep	None required	None required
1.3	Preliminary	4 borings, 7-7/8-in.-diameter, 30 ft deep: continuous undisturbed samples	Visual classification	None required(a)
		3 borings, 7-7/8-in.-diameter, 50 ft deep: 7 undisturbed samples from each	Visual classification	21 classification and water content determinations 5 consolidation 5 triaxial, constant stress ratio
	Installation	1 boring, 7-7/8-in.-diameter, 30 ft deep	None required	None required
		11 water content samples for backfill material control	11 water content determinations	None required
		14 density samples for compaction control	14 density and water content determinations	None required
	Posttest*	3 borings, 7-7/8-in.-diameter, 30 ft deep: continuous undisturbed samples	Visual classification	None required(a)
		1 boring, 7-7/8-in.-diameter, 77 ft deep: continuous undisturbed samples to 30 ft; no samples below	Visual classification	None required(a)
		1 boring, 7-7/8-in.-diameter, 21 ft deep: 3 undisturbed samples	Visual classification	3 density and water content determinations 3 consolidation 3 triaxial, constant stress ratio
		1 boring, 7-7/8-in.-diameter, 78 ft deep: no samples required	None required	None required
1.9	Installation	18 borings, 7-7/8-in.-diameter, 10 to 41 ft deep: no samples required	None required	None required
3.1	Installation	17 density samples for compaction control	17 density and water content determinations	None required
[illegible]	Preliminary	4 borings, [illegible]-in.-diameter, 31.5 ft deep: 19 general samples and penetration resistances per boring	32 classification 76 water content determinations 76 penetration resistance determinations	None required
		4 test pits, 5' x 5' x 5' deep	4 load bearing tests 8 density and water content determinations	None required
		4 borings, 7-7/8-in.-diameter, 16 ft deep: 2 undisturbed samples per boring	8 classification 8 water content determinations	8 triaxial, UU(Q), multiple stage 8 consolidation, 8 unconfined compression, 8 void ratio determinations, 4 specific gravity, 8 hydrometer analysis
	Installation	150 borings, 1-1/2-in.-diameter, 1-1/2 to 16 ft deep	None required	None required
		14 density samples of in situ soil	14 density and water content determinations	None required
	Installation	60 density samples for compaction control	60 density and water content determinations	None required
3.7	Installation	68 density samples for compaction control	68 density and water content determinations	

(a) Samples delivered to AFSWC for tests
* Incomplete

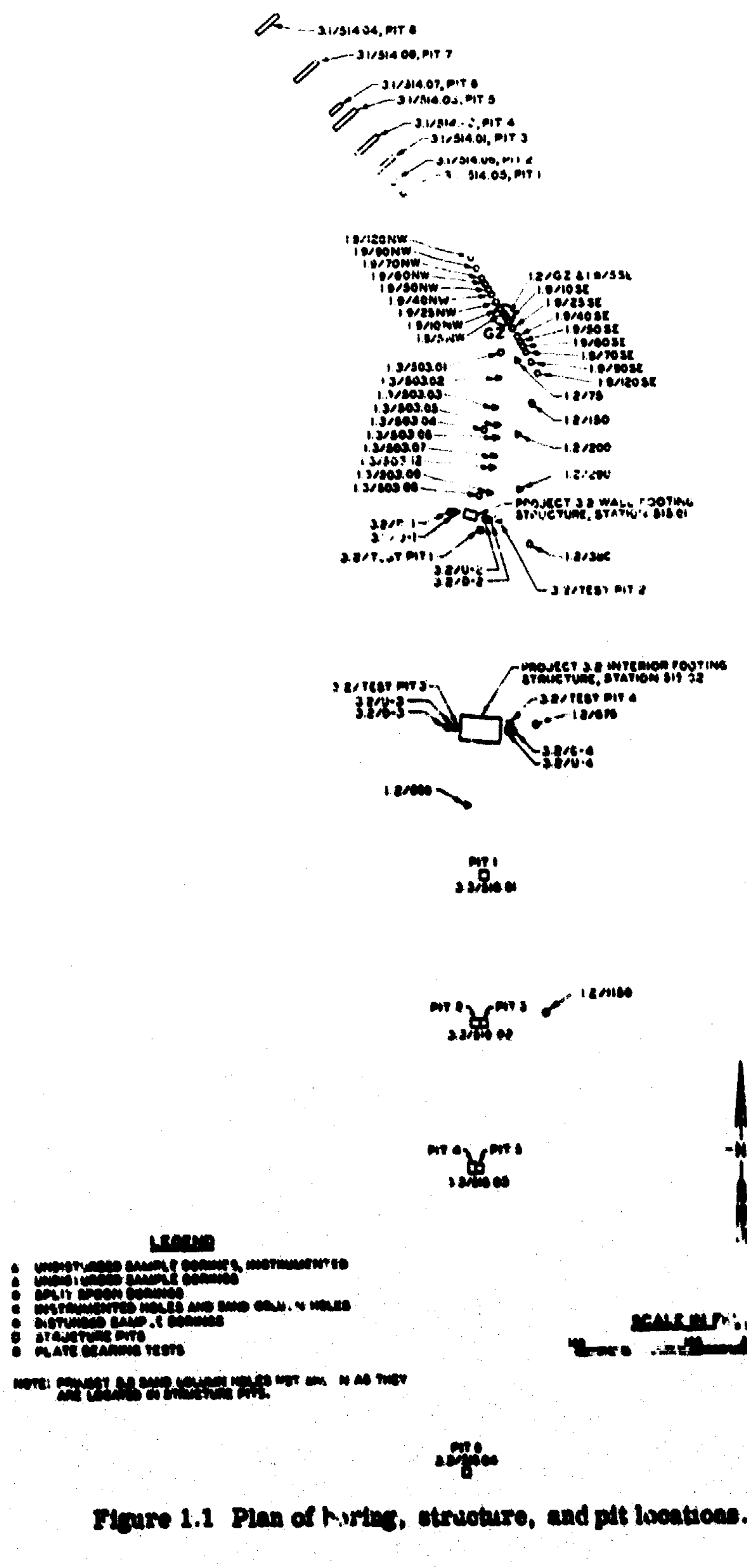


Figure 1.1 Plan of boring, structure, and pit locations.

CHAPTER 2

PROCEDURE

Field and laboratory operations and procedures used for sampling and testing of soils throughout this project are described in this chapter.

The soils survey project officer, drill crew, laboratory technicians, and all soil exploration and testing equipment were furnished by WES. A headquarters operations office was set up at Camp Mercury, NTS, and a field laboratory was set up in a van-type trailer in FF. Field exploration and testing equipment used on the project included: (1) a truck-mounted, rotary drill rig and accessory drilling equipment; (2) apparatus for determining in-place density of soil; and (3) load bearing test apparatus. The field laboratory was equipped with the necessary testing equipment for the determination of water content, gradation, Atterberg limits, and density of soils. Samples for strength and consolidation tests were tested by the WES soils laboratory in Vicksburg.

2.1 BORING AND SAMPLING

Field boring and exploration included: (1) undisturbed sample borings, (2) split spoon sample borings, (3) general (disturbed) sample borings, (4) holes for instrumentation,

and (5) in-situ and compaction control density samples. Data on all borings and field tests performed are shown in Table 2.1.

2.1.1 Undisturbed 6-inch-Diameter Samples. Undisturbed 6-inch-diameter samples were obtained from borings for Projects 1.2, 1.3, and 3.2 with a truck-mounted rotary drill rig using a 6-inch by 7-3/4-inch diameter double-tube core barrel, a basket-type core lifter, and a special bottom discharge core bit set with carboloy inserts as shown in Figure 2.1. The bore hole was reamed and/or advanced after obtaining each sample with the 7-7/8-inch-diameter three-way, carboloy insert drill bit, followed by a 7-7/8-inch-diameter guide (Figure 2.2). The cuttings were removed from the hole by compressed air as the coring or drilling progressed. The samples were removed from the core barrel as shown in Figure 2.3. A small specimen was cut off the bottom of each sample and sealed in a pint glass jar for use in making water content determinations and classification tests. Each undisturbed sample was placed on a grooved wooden block as shown in Figure 2.4, a 7-inch-diameter cardboard tube was placed over the sample, and the annular space between the sample and the tube was then filled with melted paraffin and

microcrystalline wax as shown in Figure 2.5. After the wax had hardened, the undisturbed samples were packed in cushioning material in wooden shipping boxes and shipped to the WES soils laboratory in Vicksburg.

2.1.2 Split Spoon Samples. Split spoon samples were obtained for Project 3.2 by driving a 2-inch-outside-diameter, 1-3/8-inch-inside-diameter split spoon sampler 18 inches into the in-situ soil by means of a 140-pound hammer, with a drop of 30 inches, operated by means of the cathead on the drill rig. The borings were advanced between samples by conventional rotary drilling methods, using a three-way, 3-1/2-inch-diameter carboloy insert bit for cutting the soil and compressed air for removing the cuttings from the bore hole. Split spoon samples were sealed in pint glass jars and stored in the field laboratory for testing.

2.1.3 General Samples. One exploratory boring was made for Project 1.2 in which general (disturbed) soil samples were taken. The boring was advanced with a three-way, 3-1/2-inch-diameter carboloy insert bit to the depth at which the sample was desired, and all cuttings were removed with compressed air and wasted. The hole was then advanced 1 foot, and all cuttings from this 1-foot penetration were caught and a representative sample was sealed in a pint glass jar for later testing.

2.1.4 Density Samples. Density samples were obtained by means of two types of density sampling apparatus. Samples of compacted fine-grained backfill material used on Projects 1.3 and 3.2 and samples of in-situ undisturbed soil in Project 3.2 pits were taken by means of a drive sampler apparatus using 3-inch-diameter, 3-inch-long steel sample tubes. The samples were removed from the tubes in the field and tested immediately. Densities of the compacted sand backfill used on Projects 3.1 and 3.3 were determined by means of a box density sampler apparatus, since conventional techniques for making density determinations could not be used on these cohesionless sands. The integral parts of the box sampler are shown in Figure 2.6. The sample box was pushed into the compacted sand backfill until the top of the box was about flush with the surface of the backfill. The trowel (H) was used to remove soil from under the box flanges as the box was forced into the soil. Spacer bars (D) were then fastened to the flanged top of the box with the spacer clamp blocks (E) to provide a 2-inch extension above the top of the box. The clean-out tools (B and C) were used to remove the soil from the box to a depth controlled by the guide edges on the tools contacting the top of the spacer bars. The box-like tool (C) was used to remove the greater

portion of the soil, and the blade tool (B) was then used to ensure removal of the rest of the soil to a uniform depth. All soil removed in this first operation was discarded. The spacer bars were then taken off and soil for the density sample was removed progressively from the box in the same manner to the uniform depth controlled by the clean out tool. This procedure made it possible to obtain a sample of known in-place volume. Figure 2.7 shows the soil being removed from the sampler box after the spacer bars had been removed.

2.1.5 Instrumentation Holes. Holes were drilled to various depths for Projects 1.2, 1.3, 1.9, and 3.2 for installation of sand columns and various types of instrumentation devices. Instrumentation holes were drilled for Projects 1.2, 1.3, and 1.9 by means of the truck-mounted rotary drill rig by use of the 7-7/8-inch-diameter three-way carboloy insert drill bit, followed by the 7-7/8-inch-diameter guide shown in Figure 2.2. Undisturbed 6-inch-diameter samples were obtained from some of the instrument holes by the method described in Paragraph 2.1.1. Instrumentation holes were drilled for Project 1.2 with a 6-inch-diameter Iwan-type hand auger. Instrumentation holes were drilled

for Project 3.2 with a 1-1/2-inch-diameter carboloy insert drill bit rotated by a 1/2-horsepower electric motor through special, 0.840-inch-outside-diameter drill rods. All cuttings were removed from instrumentation holes and sand columns by compressed air as the drilling progressed.

2.1.6 Identification and Shipment. Borings and pits were identified by numbers assigned by project officers, as shown in Table 2.1. Samples taken from borings and pits were additionally identified by sample number and depth below ground surface. Samples shipped to the WES soils laboratory, Vicksburg, for testing were processed through Rad-Safe and the DOD Support Group.

2.2 FIELD TESTS

Tests performed in the field included penetration resistance tests and load bearing tests. Tests performed in the field laboratory were classification, Atterberg limits, water content, and density.

2.2.1 Penetration Resistance. Penetration resistance tests were made in conjunction with the split spoon sample borings (Paragraph 2.1.2) by recording the number of blows required to drive the sampler each 6-inch increment of the 18-inch penetration. These tests were performed to obtain data on the relative penetration resistance of the soil

with depth. The number of blows for sampler penetration from 6 to 18 inches was used to express the penetration resistance in terms of number of blows per foot.

<u>2.2.2 Load Bearing.</u> Four load bearing tests were performed for Project 3.2. A pit was first excavated, 5 feet square and 5 feet deep. A 21- by 13-inch, 127-pound I-beam, 17 feet long, was then centered across the pit and bolted to a pair of channel beams anchored at each end by two 10-inch diameter soil anchors attached to 10-foot-long, 2-3/8-inch-diameter stems as shown in Figure 2.8a. A 1-foot-square, 1-inch-thick steel plate was seated firmly on a 1/4-inch layer of fine sand in the center of the bottom of the pit. A 100-ton-capacity hydraulic jack equipped with a pressure gage was then placed on top of an 8-inch-diameter pipe column (see Figure 2.8b) centered on the plate and jacking pressures were applied against the I-beam in increments of 1 or 2 tons/sq ft. Each increment was held until rate of settlement became less than 1/3 inch in 10 minutes. The test was continued until a settlement of at least 6 inches had occurred or until a load of at least 30 tons/sq ft had been applied. Settlement of the plate was measured by the dial gage apparatus shown in Figure 2.8b.

2.2.3 Field Classification. All samples were classified in the field visually and Atterberg limits tests were performed on selected samples. The classification was based on the Corps of Engineers Unified Soil Classification System (see Reference 1).

2.2.4 Field Density and Water Content. Densities of both the in-situ undisturbed soil in the pits and of compacted fine-grained backfill materials were determined in the field on samples obtained with the drive sampler apparatus. Densities of compacted sand backfill were determined on samples obtained with the box density sampler apparatus, since conventional techniques, such as the sand cone method and the balloon method, could not be used in these dry cohesionless soils. The water content of the density samples was determined in the field laboratory by drying weighed quantities of the materials in pans over direct heat.

2.3 LABORATORY TESTS

Tests performed by the WES soils laboratory in Vicksburg included classification, density, water content, consolidation

tests, unconfined compression tests, and triaxial compression tests.

2.3.1 Classification Tests. Classification tests were performed on material from selected undisturbed samples, including mechanical analyses, Atterberg limits, and specific gravity tests, using procedures described in Reference 2.

2.3.2 Density and Water Content Determinations. Density and water content tests were made on selected undisturbed samples in the WES soils laboratory to determine in-situ characteristics of the soils.

2.3.3 Consolidation Tests. Consolidation tests were performed on undisturbed soil samples to determine the compressibility characteristics of the in-situ soils. Fixed-ring consolidometers, using specimens 2.5 inches in diameter and 0.75 inch thick, were used for all consolidation tests. The specimens were tested at their natural water contents, and no water was introduced during the tests.

Procedures followed for the consolidation tests were developed as a result of experience gained during performance of the initial phase tests conducted on FF soil for Operation Plumbbob Project 3.8 in 1957. Specimens tested were trimmed in the humid room, assembled in the consolidometers,

and placed in the loading frame. The load increments were applied at 8-minute intervals; each test required about 4 hours to complete. Some specimens were loaded to 25 tons/sq ft, unloaded to the tare load, loaded to 100 tons/sq ft, and unloaded to the tare load. Other specimens were loaded to 100 tons/sq ft and unloaded to the tare load. The apparatus was then disassembled and the final water content of the specimen determined.

2.3.4 Unconfined Compression Tests. Unconfined compression tests were made on selected undisturbed samples by the controlled strain method, using standard procedures described in Reference 2.

2.3.5 Triaxial Tests: Unconsolidated-Undrained, Multiple-Stage. The multiple-stage unconsolidated-undrained (Q) triaxial tests were performed to determine the shear strength of the soil tested. All test specimens were trimmed in the humid room to a diameter of 1.4 inches and a height of approximately 3 inches. The tests were performed at a constant rate of strain. The multiple-stage procedure was used so that the shear strength curve could be developed from a single specimen.

In the multiple-stage procedure, an initial lateral pressure was applied to the test specimen and the vertical

load was increased until failure was imminent as indicated by the curvature of the stress-axial strain plot; then a higher lateral pressure was applied and the vertical load was increased until failure was again imminent. Finally, a third (and sometimes a fourth), still higher lateral pressure was applied until failure occurred under increasing vertical load. Except for the use of the multiple-stage procedure, the test method corresponded with the procedure for triaxial tests described in Reference 2.

2.3.6 Triaxial Tests: Constant Stress Ratio. Constant-stress ratio triaxial tests were performed on undisturbed specimens at a constant rate of strain to determine the stress-strain characteristics of the soil tested. Test specimens 1.4 inches in diameter and approximately 3 inches high were used. After the specimens had been placed in the test apparatus, an initial lateral confining pressure equivalent to the existing overburden pressure in nature was applied. Then, increments of deviator stress and additional confining pressure were applied at a ratio of 4 to 1. The ratio of 4 proved adequate in that the specimen generally did not fail at this ratio. Except for the use of the constant stress ratio, the conduct of the test followed the procedure described for triaxial tests in Reference 2.

TABLE 2.1 BORINGS AND FIELD TESTS PERFORMED

Project	Boring, Pit or Station No.	Size or Diameter	Depth Drilled	Type Samples	Location from GZ: Bearing	Location from GZ: Radial Distance from GZ	Location from GZ: Offset
						ft	
1.2	1.2/GZ	7-7/8"	252.2	Undisturbed	S 16°32'44" E	5	1' W
	1.2/75'	10"	[illegible]	Undisturbed	S 16°32'44" E	75	0'
	1.2/150'	3-1/2"	190.2'	[illegible]	S 16°32'44" E	150	5' E
	1.2/200'	7-7/8"	254.0'	Undisturbed	150' S 16°32'44" E then S 1°34'25" E	200	20' W
	1.2/290'	7-7/8"	152.2'	Undisturbed	150' S 16°32'44" E then S 1°34'25" E	290	20' W
	1.2/300'	7-7/8"	75'	Undisturbed	S 5°04'33" W	307.3	--
	1.2/380'	6"	5'	None	150' S 16°32'44" E then S 1°34'25" E	380	5'10" W
	1.2/675'	6"	5'	None	150' S 16°32'44" E then S 1°34'25" E	675	4'6" W
	1.2/1150'	6"	5'	None	150' S 16°32'44" E then S 1°34'25" E	1150	5'2" W
1.3	1.3/503.01-1	7-7/8"	30.0'	None	S 06°25'36" W	50	0'
	1.3/503.02-1	7-7/8"	30.8'	Undisturbed	S 06°25'36" W	100	0'
	1.3/503.03-1	7-7/8"	30.3'	Undisturbed	S 06°25'36" W	150	0'
	1.3/503.05-1	7-7/8"	52.0'	Undisturbed	S 06°25'36" W	180	4' E
	1.3/503.06-1	7-7/8"	30.5'	Undisturbed	S 06°25'36" W	200	4' E
	1.3/503.07-1	7-7/8"	52.0'	Undisturbed	S 06°25'36" W	230	4' E
	1.3/503.09-1	7-7/8"	52.5'	Undisturbed	S 06°25'36" W	290	4' E
	1.3/503.12-1	7-7/8"	30.4'	Undisturbed	S 05°25'36" W	250	4' E
	1.3/503.04-1*	36"	20.0'	Density	S 06°25'36" W	190	15' W
	1.3/503.08-2*	36"	30.0'	Density	S 06°25'36" W	[illegible]	15' W
	1.3/503.02-2	7-7/8"	31.0'	Undisturbed	S 06°25'36" W	100	5' W
	1.3/503.03-2	7-7/8"	31.0'	Undisturbed	S 06°25'36" W	150	5' W
	1.3/503.05-2	7-7/8"	20.9'	Undisturbed	S 06°25'36" W	180	5' E
	1.3/503.06-2	7-7/8"	77.0'	Undisturbed**	S 06°25'36" W	203	6' W
	1.3/503.09-2	7-7/8"	78.0'	None	S 06°25'36" W	295	4' E
	1.3/503.12-2	7-7/8"	31.0'	Undisturbed	S 06°25'36" W	254	4' E
1.9	1.9/5 SE	7-7/8"	41.0'	None	S 31°35'25" E	5	0
	1.9/10 SE	7-7/8"	40.0'	None	S 31°35'25" E	10	0
	1.9/25 SE	7-7/8"	25.0'	None	S 31°35'25" E	25	0
	1.9/40 SE	7-7/8"	20.0'	None	S 31°35'25" E	40	0
	1.9/50 SE	7-7/8"	15.0'	None	S 31°35'25" E	50	0
	1.9/60 SE	7-7/8"	10.0'	None	S 31°35'25" E	60	0
	1.9/70 SE	7-7/8"	10.0'	None	S 31°35'25" E	70	0
	1.9/90 SE	7-7/8"	10.0'	None	S 31°35'25" E	90	0
	1.9/120 SE	7-7/8"	10.0'	None	S 31°35'25" E	120	0
	1.9/5 NW	7-7/8"	41.0'	None	N 31°35'25" W	5	0
	1.9/10 NW	7-7/8"	40.0'	None	N 31°35'25" W	10	0
	1.9/25 NW	7-7/8"	25.0'	None	N 31°35'25" W	25	0
	1.9/40 NW	7-7/8"	20.0'	None	N 31°35'25" W	40	0
	1.9/50 NW	7-7/8"	15.0'	None	N 31°35'25" W	50	0
	1.9/60 NW	7-7/8"	10.0'	None	N 31°35'25" W	60	0
	1.9/70 NW	7-7/8"	10.0'	None	N 31°35'25" W	70	0
	1.9/90 NW	7-7/8"	10.0'	None	N 31°35'25" W	90	0
	1.9/120 NW	7-7/8"	10.0'	None	N 31°35'25" W	120	0
3.1	514.01	6' x 48'	7" to 14"	Density	N 40°00'00" W	320	-- (center of pit)
	514.02	6' x 48'	7" to 14"	Density	N 40°00'00" W	365	-- (center of pit)
	514.03	6' x 48'	3-1/2 to 13"	Density	N 40°00'00" W	480	-- (center of pit)
	514.04	6' x 48'	3-1/2" to 6-1/2"	Density	N 40°00'00" W	630	-- (center of pit)
	514.05	6' x 12'	8" to 14"	Density	N 40°00'00" W	865	-- (center of pit)
	514.06	6' x 12'	8" to 14"	Density	N 40°00'00" W	890	-- (center of pit)
	514.07	6' x 24'	5-1/2" to 12"	Density	N 40°00'00" W	445	-- (center of pit)
	514.08	6' x 48'	5-1/2" to 9-1/2"	Density	N 40°00'00" W	585	-- (center of pit)
3.2	515.01	12' x 26-1/2'	9.5'	Density	S 10°21'36" W	332	-- (center of 12' wide (along project line) by 26-1/2' long structure)
	D-1	3-1/2"	51.5'	Split spoon	--	--	36.5' S 73°38'24" W of center of structure 515.01
	D-2	3-1/2"	51.5'	Split spoon	--	--	36.5' N 73°38'24" E of center of structure 515.01
	U-1	7-7/8"	16.9'	Undisturbed	--	--	28.5' S 73°38'24" W of center of structure 515.01
	U-2	7-7/8"	16.0'	Undisturbed	--	--	28.5' N 73°38'24" E of center of structure 515.01
	Test Pit 1	5' x 5'	5'	Density & plate bearing	--	--	28.5' N 45°41'28" E of center of structure 515.01
	Test Pit 2	5' x 5'	5'	Density & plate bearing	--	--	34.5' S 73°38'24" E of center of structure 515.01
	515.02	41' x 40'	10.4'	Density	S 04°02'45" W	400	-- (center of 41' wide (along project line) by 40' long structure)
	D-3	3-1/2"	51.5'	Split spoon	--	--	55.0' S 85°37'17" W of center of structure 515.02
	D-4	3-1/2"	51.5'	Split spoon	--	--	55.0' N 85°37'17" E of center of structure 515.02
	U-3	7-7/8"	16.8'	Undisturbed	--	--	50.0' S 85°37'17" W of center of structure 515.02
	U-4	7-7/8"	16.8'	Undisturbed	--	--	[illegible] of center of structure 515.02
	Test Pit 3	5' x 5'	5'	Density & plate bearing	--		[illegible] structure 515.02
	Test Pit 4	5' x 5'	5'	Density & plate bearing	--	--	[illegible] of center of structure 515.02
	515.01	3-1/2"	6' to 10'	None	88 holes drilled in and around [illegible]		
	515.02	3-1/2"	1-1/2' to 10'	None	68 holes drilled in floor of [illegible]		
3.3	516.01	16'3" x 17'0"	6'0"	Density	S 8°25'35" W	910	-- (center of [illegible] edge of Pit No. 1)
	516.02	13'3" x 18'9"	5'6"	Density	S 8°25'35" W	1160	-- (center of [illegible] edge of Pit No. 2)
	516.03	18'7-1/2" x 11'1"	[illegible]	Density	S 8°25'35" W	1160	-- (center of W edge of Pit No. 3)
	516.03	13'10" x 8'11"	5'6"	Density	S 8°25'35" W	1400	-- (center of E edge of Pit No. 3)
	516.05	13'0" x 10'7"	6'6"	Density	S 8°25'35" W	1400	-- (center of [illegible] edge of Pit No. 4)
	516.04	11'0" x 11'[illegible]"	5'0"	Density	S 8°25'35" W	1400	-- (center of E edge of Pit No. 4)

* Drilled by [illegible]

** Undisturbed to 31 ft; no samples below 31 ft

Figure 2.1 View of rotary drill rig showing 6 by 7¾-inch-diameter double-tube core barrel and a special bottom discharge core bit set with carboloy inserts. (DASA-295(NOU-238-06)NTS-62 photo)

Figure 2.2 View of rotary drill rig showing $7\frac{7}{8}$-inch-diameter three-way, carboloy insert drill bit, and $7\frac{7}{8}$-inch-diameter guide. (DASA-29-07-NTS-63 photo)

Figure 2.3 Removing 6-inch-diameter undisturbed soil sample from core barrel. (DASA-29-08-NTS-63 photo)

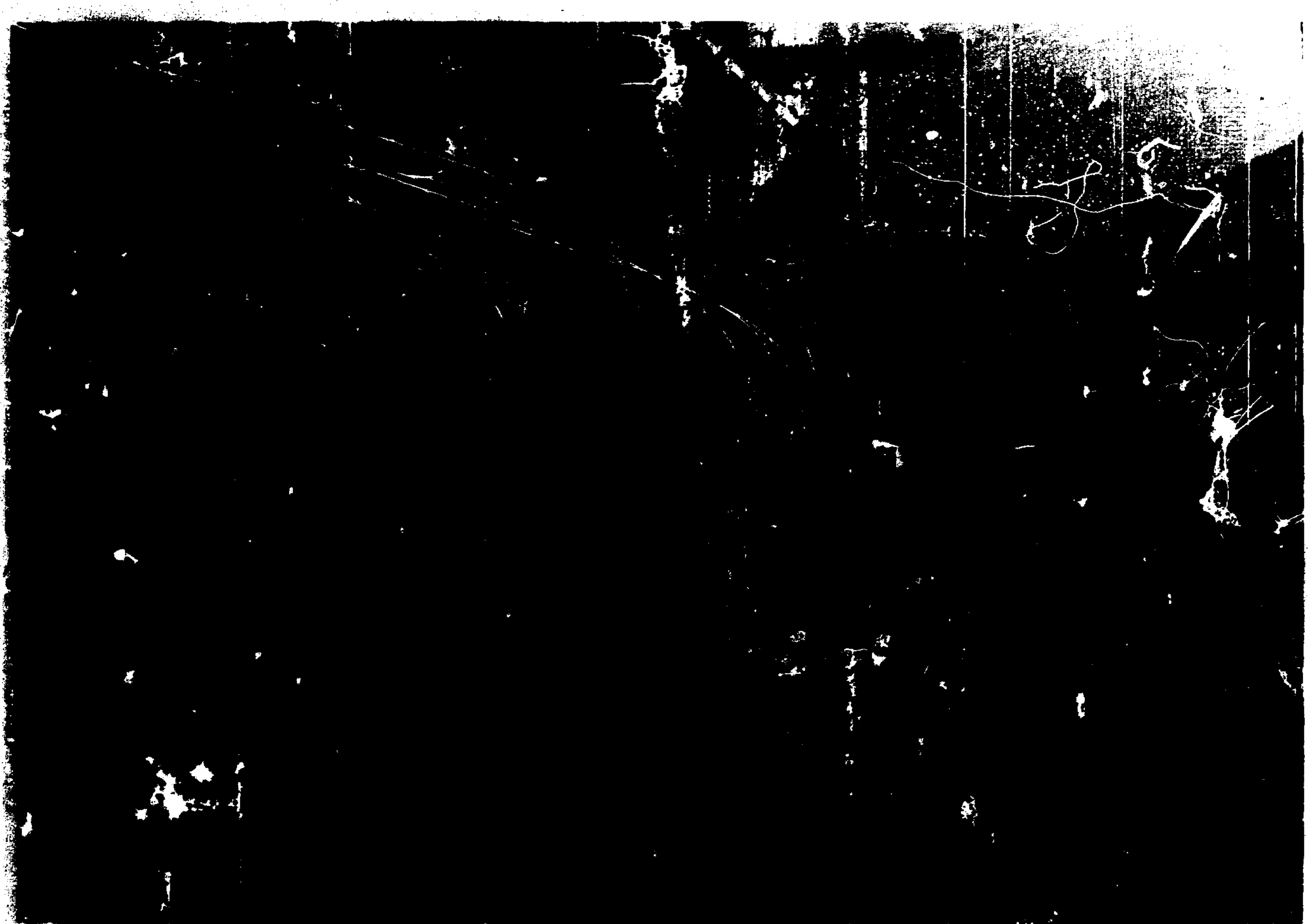


Figure 2.4 Undisturbed 6-inch-diameter soil sample on grooved wooden block. (DASA-29-09-NTS-68 photo)

Figure 2.5 Undisturbed 6-inch-diameter soil sample encased in cardboard tube and wax. (DASA-295(NOU-9-238-07)NTS-6" photo)

Figure 2.6 Integral parts of box density sampler. (DASA-29-03-NTS-63 photo)

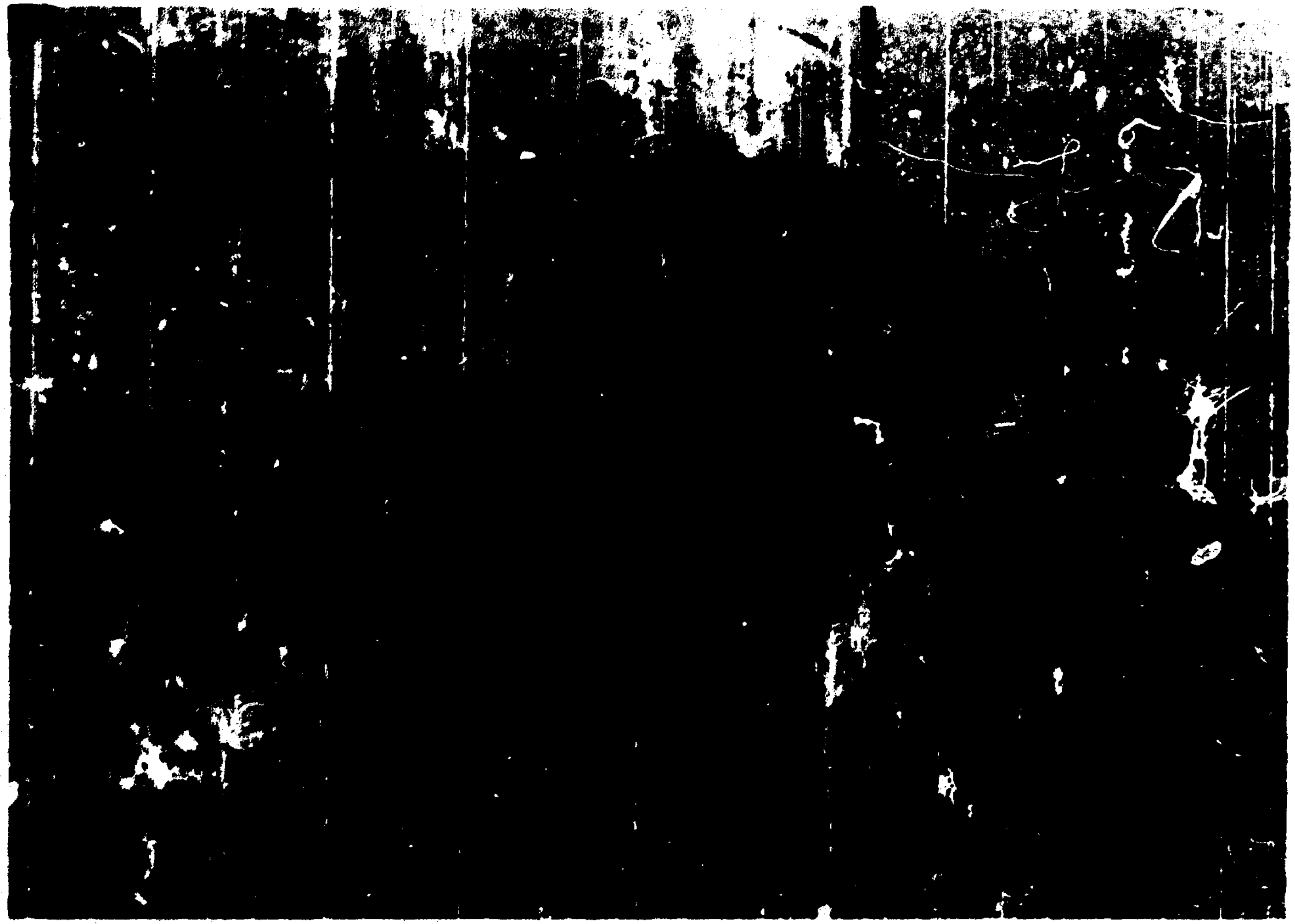


Figure 2.7 Removing density sample from box sampler. (DASA-29-01-NTS-63 photo)

Figure 2.8a Load bearing test apparatus. View showing reaction beam, anchor beam, reference bar for settlement gages and hydraulic jack. (DASA 516-4-NTS-62 photo)

Figure 2.8b Load bearing test apparatus. View showing test pit, pipe column, settlement and pressure dial gages, and hydraulic jack. (DASA 516-5-NTS-62 photo)

CHAPTER 3

RESULTS

3.1 PROJECT 1.2

Five undisturbed sample borings and one general (disturbed) sample boring were required during the preliminary phase to obtain soil samples for testing to determine the pretest characteristics of the subsurface soils, and 3 borings were required for instrument holes during the installation phase. Tests were performed on selected samples in both the field laboratory and the WES soils laboratory in Vicksburg. The locations of the holes are shown in Figure 1.1.

3.1.1 Preliminary Phase. A total of 81 undisturbed samples and 1 general sample were obtained from borings 1.2/GZ, 1.2/75', 1.2/200', 1.2/290', and 1.2/800'. Atterberg limits and water contents were run in the field laboratory on the general sample and on material cut from the bottom of each undisturbed sample. The results of these tests are shown in Table 3.1.

Consolidation and multiple-stage unconsolidated-undrained triaxial tests were performed in the WES soils laboratory on 9 selected samples from boring 1.2/GZ, and a multiple-stage triaxial test was performed on one sample from boring 1.2/800'. A summary of the soil properties obtained from these tests

is shown in Table 3.1. A more detailed summary of consolidation test results is shown in Table 3.2. Pressure-void ratio curves are shown in Figures 3.1 and 3.2, and stress-strain curves are shown in Figures 3.3 through 3.5. Data and curves obtained from the triaxial tests are shown in Figures 3.6 through 3.15.

The general sample boring, 1.2/150', was drilled for use in planning and constructing a shaft at the boring location. A log of the boring showing sample depth and visual classification, together with the disturbed samples obtained, was delivered to the 1.2 Project Officer as soon as the boring was completed. No tests were performed on the samples from boring 1.2/150'.

3.1.2 Installation Phase. Three instrumentation holes 1.2/380', 1.2/675', and 1.2/1150', were drilled during the installation phase. Also, four holes, 1.2/GZ, 1.2/75', 1.2/200', and 1.2/290', drilled during the preliminary phase were cleaned out for use as instrumentation holes. These holes had been left open and covered with sheet plastic and plywood, but some sloughing had occurred and partially filled the holes.

3.2 PROJECT 1.3

Instrumentation holes and data on both the preten...

and posttest physical characteristics of the subsurface soils were required by Project 1.3, and density and water content samples of the compacted silt were required for backfill placed in the large-diameter instrumented holes during the installation phase. Undisturbed samples were obtained from 12 borings. The locations of the borings and instrumented holes are shown in Figure 3.16. Tests were performed on selected samples in both the field laboratory and the WES soils laboratory in Vicksburg.

3.2.1 Preliminary Phase. Continuous undisturbed samples were obtained to a depth of 30 feet from borings 1.3/503.02-1, 1.3/503.03-1, 1.3/503.06-1, and 1.3/503.12-1. At some depths, 100-percent sample recovery was not obtained. As a result, offset borings were made to obtain undisturbed samples at the depths where samples were not obtained in the original boring. No tests were performed by WES on these samples. The log of these borings showing sample depths and visual classification, together with the samples, was delivered to the Project Officer for tests to be performed by others.

A total of 21 undisturbed samples were obtained at specified depths from borings 1.3/503.05-1, 1.3/503.[illegible], and 1.3/503.09-1. The undisturbed samples were shipped

to the WES soils laboratory in Vicksburg for testing. Atterberg limits and water content determinations were made on all of the samples. Density tests were run on 15 of the samples. Five consolidation and 4 constant-stress ratio triaxial tests were performed. A summary of the soil properties obtained from these tests is shown in Table 3.3. A more detailed summary of consolidation test results is shown in Table 3.4. Pressure-void ratio curves are shown in Figures 3.17 and 3.18 and stress-strain curves are shown in Figures 3.19 and 3.20. Data and curves obtained from the triaxial tests are shown in Figures 3.21 through 3.23.

3.2.2 Installation Phase. One instrumentation hole, 1.3/503.01-1, was drilled and 6 of the undisturbed sample borings drilled during the preliminary phase were reamed out for use as instrumentation holes. These holes had been left open and covered with sheet plastic and plywood, but some sloughing had occurred, partially filling the holes.

Fourteen density and water content samples were obtained and tested in the field laboratory from the compacted silt backfill placed in two 36-inch diameter instrumented holes, 1.3/503.04-1 and 1.3/503.08-1, which

were drilled by others. The silt was placed in 3-inch-thick lifts and compacted with air tamps. Water content and density data are shown in Table 3.5.

3.2.3 Posttest Phase. Continuous undisturbed samples were obtained to a depth of 30 feet from borings 1.3/503.02-2, 1.3/503.03-2, 1.3/503.06-2, and 1.3/503.12-2. The logs of these borings showing sample depths and visual classification, together with the samples, were delivered to the 1.3 Project Officer for tests to be performed by others.

Three undisturbed samples were obtained at specified depths from boring 1.3/503.05-2. The undisturbed samples were shipped to the WES soils laboratory in Vicksburg for testing. Atterberg limits, density, water content, consolidation and constant-stress ratio triaxial tests were performed on the samples. A summary of the soil properties obtained from these tests is shown in Table 3.6. A summary of consolidation test results is shown in Table 3.7. Pressure-void ratio curves are shown in Figures 3.24 and stress-strain curves are shown in Figure 3.25. Data and curves obtained from the triaxial tests are shown in Figures 3.26 through 3.28.

Borings 1.3/503.06-2 and 1.3/503.09-2 were left [illegible] and covered with sheet plastic and plywood for later use as posttest instrumentation holes.

3.3 PROJECT 1.9

3.3.1 Installation Phase. Eighteen 7-7/8-inch-diameter holes were drilled for the installation of colored sand columns. Soils survey services were not required for Project 1.9, other than to provide these holes.

3.4 PROJECT 3.1

3.4.1 Installation Phase. Fifteen density samples of compacted sand backfill were obtained from eight model structure installation pits located as shown in Figure 3.29 to determine the as-placed density and water contents of the backfill. The water content and density of the compacted sand backfill are shown in Table 3.8.

3.5 PROJECT 3.2

Holes were required for the installation of sand columns adjacent to test footings, and field tests were required to obtain strength data on the in-situ soils. Undisturbed samples of in-situ soils and backfill were required for laboratory tests to determine the classification, water content, density, strength, and compressibility of the soils. The location of borings and field tests are shown in Figure 3.30.

3.5.1 Preliminary Phase. Four split spoon borings, D-1, D-2, D-3, and D-4, were drilled to obtain penetration resistance and soil samples for tests.

Penetration resistance data, and water content and Atterberg limits determined from tests on the split spoon samples in the field laboratory are plotted with reference to depth in Figure 3.31.

Eight undisturbed samples were obtained from borings U-1, U-2, U-3, and U-4. Atterberg limits and water content determinations were made on the samples in the field laboratory. Mechanical analysis, void ratio, density, unconfined compression, consolidation, and multiple-stage triaxial tests were performed on selected samples in the WES soils laboratory in Vicksburg. A summary of soil properties determined from the tests is shown in Table 3.9.

Stress versus strain curves and soil properties obtained from the unconfined compression tests are shown in Figure 3.32.

Pressure-void ratio curves and soil properties obtained from the consolidation tests are shown in Figure 3.33.

The results of the multiple-stage triaxial tests are shown in Figure 3.34.

Four load bearing tests were made in test pits Nos. 1, 2, 3, and 4. Settlement versus load curves from these tests are shown in Figure 3.35.

Density samples of the undisturbed in-situ soil were

taken in the bottom of each test pit adjacent to the load bearing plate and from the floor of the structure pits. Water content and density data from these samples are shown in Table 3.9.

3.5.2 Installation Phase. Water content and density samples were obtained from the compacted silt backfill placed back of the test walls of the footing structure and around the perimeter of the interior footing structure. The silt was compacted in 3-inch-thick lifts by air tamps. The water content and density of the silt backfill behind the walls of the wall footing structure are shown in Table 3.10 and in Table 3.11 for fill around the perimeter of the interior footing structure.

During the installation phase, 88 holes, 1-1/2 inches in diameter, were drilled from 4 to 16 feet deep in and around the wall footing structure pit; and 62 holes, 1-1/2 inches in diameter, were drilled from 1-1/2 to 10 feet deep in the floor of the interior footing structure pit. The holes were backfilled with colored sand.

3.6 PROJECT 3.3

3.6.1 Installation Phase. Density and water content samples were obtained from the compacted sand backfill in six model structure installation pits, located as shown in Figure 3.35. The final density and water content data for the as-placed backfill are shown in Table 3.12.

TABLE 3.1 PROJECT 1.2, SUMMARY OF SOIL PROPERTIES

Boring No.	Distance from GZ	Depth From	Depth To	Sample No.	Type of Sample	Field Laboratory Tests: Classification	Field: w.c.	Field: Liquid Limit	Field: Plastic Limit	WES Consolidation Initial: γ_d	WES Consolidation Initial: w.c.	WES Triaxial Initial: γ_d	WES Triaxial Initial: w.c.	WES Triaxial: ϕ	WES Triaxial: c
	ft	ft	ft				pct			lb/cu ft	pct	lb/cu ft	pct	degrees	ton/sq ft
1.2/GZ	5	11.4	11.6	1A	Disturbed	ML	12.0	36.5	[illegible]	--	--	--	--	--	--
		20.0	20.1	2A	Disturbed	ML	15.0	--	--	--	--	--	--	--	--
		30.0	31.6	3	Undisturbed		--	--	--	83.3	[illegible]	[illegible]	14.1	32.[illegible]	[illegible]
		[illegible]	31.8	3A	Disturbed	ML	[illegible]	36.0	26.6	--	--	--	--	--	--
		40.0	41.3	4	Undisturbed	ML	--	--	--	86.8	15.3	86.7	14.4	31.7	1.59
		41.3	41.5	4A	Disturbed	ML	10.6	31.7	27.1	--	--	--	--	--	--
		51.3	51.5	5A	Disturbed	ML	13.2	40.3	37.0	--	--	-	--	--	--
		60.0	61.4	6	Undisturbed	ML	--	--	--	90.4	16.[illegible]	86.2	15.3	33.5	2.40
		61.4	[illegible]	6A	Disturbed	ML	17.1	39.[illegible]	25.8	--	--	--	--	--	--
		71.6	72.0	7A	Disturbed	ML	19.4	37.6	25.3	--	--	--	--	--	--
		72.0	73.8	7	Undisturbed	ML	--	--	--	90.7	17.6	89.2	17.6	30.5	2.46
		80.0	81.7	8	Undisturbed	ML	--	--	--	75.8	13.1	91.5	10.9	26.2	1.74
		81.7	81.9	8A	Disturbed	ML	9.6	30.5	27.9	--	--	--	--	--	--
		90.0	90.2	9A	Disturbed	ML	11.6	30.3	26.5	--	-	--	--	--	--
		90.2	92.0	9	Undisturbed	ML	--	--	--	80.0	15.7	83.1	12.3	[illegible]	1.56
		99.8	100.0	10A	Disturbed	ML	19.6	39.3	27.9	--	--	--	--	--	--
		100.0	101.6	10	Undisturbed	ML	--	--	--	81.7	15.8	84.3	15.5	29.2	1.97
		123.8	124.0	11A	Disturbed	ML	17.8	35.8	27.2	--	--	--	--	--	--
		150.0	151.5	12	Undisturbed	ML	--	--	--	80.5	20.7	78.7	20.0	[illegible]	[illegible]
		151.5	151.7	12A	Disturbed	ML	19.3	39.2	30.0	--	--	--	--	--	--
		175.6	175.8	13A	Disturbed	ML	19.2	31.8	27.8	--	--	--	--	--	--
		199.9	200.1	14A	Disturbed	ML	17.2	--	--	--	--	--	--	--	--
		225.0	225.2	15A	Disturbed	ML	20.1	35.7	29.4		--	--	--	--	--
		250.0	251.5	16	Undisturbed	ML	--	--	--	85.0	[illegible]	83.8	13.7	28.7	[illegible]
		251.5	251.7	16A	Disturbed	ML	15.6	32.0	30.7	--	-	--	--	--	--
1.2/75	75	10.5	10.7	1A	Disturbed	ML	12.8	34.0	26.[illegible]						
		21.6	22.2	2A	Disturbed	ML	15.2	37.3	26.7						
		33.5	34.0	3A	Disturbed	ML	9.9	30.7	25.[illegible]						
		41.5	41.7	4A	Disturbed	ML	9.4	30.5	27.[illegible]						
		51.5	51.7	5A	Disturbed	ML	11.8	35.0	28.9						
		62.0	62.2	6A	Disturbed	CL-ML	17.8	41.8	25.5						
		74.2	64.4	8A	Disturbed	CL-ML	16.9	42.0	26.[illegible]						
		71.5	71.7	9A	Disturbed	ML-CL	19.4	39.7	27.3						
		81.6	81.8	10A	Disturbed	ML	10.8	27.9	21.3						
		91.9	92.2	11A	Disturbed	ML	14.8	31.3	26.6						
		101.7	101.9	12A	Disturbed	ML	16.8	34.3	26.7						
1.2/200	200	10.8	11.0	1A	Disturbed	ML	11.5	34.0	26.7						
		19.8	20.0	2A	Disturbed	ML	15.3	--	--						
		29.8	30.0	3A	Disturbed	ML	16.1	34.3	[illegible]						
		39.7	39.9	4A	Disturbed	ML	13.0	--	--						
		49.5	49.7	5A	Disturbed	ML	13.7	34.8	30.0						
		60.3	60.5	6A	Disturbed	ML	16.6	38.2	[illegible]						
		71.0	71.2	7A	Disturbed	ML	18.0	36.7	27.7						
		76.0	82.0	8A	Disturbed	ML	11.2	--	--						
		91.2	93.4	9A	Disturbed	ML	15.4	35.9	29.2						
		100.3	100.5	10A	Disturbed	ML	18.9	33.2	27.4						
		123.0	123.1	11A	Disturbed	ML	18.6	36.0	27.3						
		156.6	156.8	12A	Disturbed	ML	21.7	35.2	29.4						
		175.8	176.0	13A	Disturbed	ML	19.2	34.3	26.0						
		199.8	200.0	14A	Disturbed	ML	19.1	--	--						
		227.3	227.5	15A	Disturbed	ML	19.4	34.0	25.7						
		252.1	252.4	16A	Disturbed	ML	20.2	33.2	29.6						
1.2/290	290	11.3	11.5	1A	Disturbed	ML	10.7	39.5	33.2						
		21.5	21.7	2A	Disturbed	ML	14.3	36.3	28.2						
		31.6	31.8	3A	Disturbed	ML	13.8	34.9	26.9						
		41.5	41.7	4A	Disturbed	ML	13.3	34.9	27.5						
		51.4	51.6	5A	Disturbed	ML	13.7	30.0	30.0						
		61.5	61.8	6A	Disturbed	ML	19.1	37.[illegible]	[illegible]						
		71.8	72.0	7A	Disturbed	ML	15.7	34.2	27.3						
		81.6	81.8	8A	Disturbed	ML	[illegible]	30.5	25.[illegible]						
		91.8	92.0	9A	Disturbed	ML	[illegible]	30.[illegible]	27.8						
		102.0	102.2	10A	Disturbed	ML	[illegible]	[illegible]	26.9						
		111.4	111.6	11A	Disturbed	ML	[illegible]	[illegible]	24.8						
		121.5	121.7	12A	Disturbed	ML	20.3	37.0	28.4						
		131.4	131.6	13A	Disturbed	ML	15.5	31.8	26.3						
		141.8	142.0	14A	Disturbed	ML	18.6	26.8	25.0						
		151.7	151.9	15A	Disturbed	ML	20.5	35.0	[illegible]						
1.2/[illegible]	[illegible]	11.5	[illegible]	1A	Disturbed	ML	13.5	39.8	[illegible]						
		19.8	20.0	2A	Disturbed	ML	15.2	--	--						
		26.8	[illegible]	3A	Disturbed	ML	[illegible]	[illegible]	[illegible]						
		39.6	39.7	4A	Disturbed	ML	[illegible]	--	--						
		[illegible]	[illegible]	5A	Disturbed	ML	[illegible]	31.8	[illegible]						
		[illegible]	[illegible]	6A	Disturbed	ML	[illegible]	--	--						
		71.2	[illegible]	[illegible]	Disturbed	ML	[illegible]	[illegible]	27.0						
		78.8	79.0	8A	Disturbed	ML	[illegible]	--	--						
		90.2	90.4	9A	Disturbed	ML	14.8	[illegible]	27.0						
		100.5	100.7	10A	Disturbed	ML	18.6	--	--						
		110.8	111.0	11A	Disturbed	ML	14.1	28.4	23.5						
		120.8	121.0	12A	Disturbed	ML	15.3	--	--						
		[illegible]	[illegible]	13A	Disturbed	ML	18.4	33.0	27.1						
		154.9	155.1	14A	Disturbed	ML	18.7	--	--						
		176.8	177.0	15A	Disturbed	ML	17.6	31.7	26.7						
		201.2	[illegible]	16A	Disturbed	ML	19.1	--	--						
		226.7	[illegible]	17A	Disturbed	ML	21.2	[illegible]	31.2						
		251.8	252.0	18A	Disturbed	ML	17.8	--	--						
		276.5	276.7	19A	Disturbed	ML	20.7	37.0	28.4						
		301.5	301.7	20A	Disturbed	ML	21.8	--	--						
		[illegible]	[illegible]	[illegible]	Disturbed	ML	18.8	[illegible]	31.8						
		[illegible]	351.5	22	Undisturbed	ML	--	--	--	--	--	[illegible]	[illegible]	[illegible]	[illegible]
		[illegible]	[illegible]	22A	Disturbed	ML	22.1	34.8	30.9						
		[illegible]	375.0	23A	Disturbed	ML	[illegible]	45.2	29.8						

TABLE 3.2 PROJECT 1.2, SUMMARY OF CONSOLIDATION TEST RESULTS ON UNDISTURBED NATURAL SOIL

Specimen Location	Depth	Initial		Final		Specific Gravity*	Modulus of Deformation**	
		w.c.	γ_d	w.c.	γ_d		50 psi	100 psi
	ft	pct	lb/cu ft	pct	lb/cu ft		psi	psi
Boring 1.2/GZ Sample No. 3	30.0 to 31.6	15.0	83.3	14.8	99.3	2.69	3,580	3,450
Boring 1.2/GZ Sample No. 4	40.0 to 41.3	15.3	86.8	15.0	101.7	2.69	3,850	4,550
Boring 1.2/GZ Sample No. 6	60.0 to 61.4	16.7	90.4	16.4	102.6	2.69	6,250	6,630
Boring 1.2/GZ Sample No. 7	72.0 to 73.8	17.6	90.7	17.4	103.1	2.[illegible]	5,550	6,660
Boring 1.2/GZ Sample No. 8	80.0 to 81.7	13.1	75.8	12.7	92.3	2.69	4,550	4,760
Boring 1.2/GZ Sample No. 9	90.2 to 92.0	15.7	80.0	15.3	99.2	2.69	4,160	4,760
Boring 1.2/GZ Sample No. 10	100.0 to 101.6	15.8	81.7	15.0	97.8	2.69	5,000	4,540
Boring 1.2/GZ Sample No. 12	150.0 to 151.5	20.7	80.5	20.3	95.7	2.69	5,550	5,260
Boring 1.2/GZ Sample No. 16	250.0 to 251.5	17.5	85.0	17.3	96.1	2.69	12,500	9,100

*Estimated
**At stress stated in column heading

TABLE 3.3 PROJECT 1.3, SUMMARY OF SOIL PROPERTIES (PRETEST)

Boring No.	Distance From GZ	Depth From	Depth To	Sample No.	Type of Sample	Laboratory Tests: Classification	Initial w.c.	Initial γ_d	Liquid Limit	Plastic Limit	Consolidation γ_d	Consolidation w.c.	Triaxial γ_d	Triaxial w.c.
	ft	ft	ft				pct	lb/cu ft			lb/cu ft	pct	lb/cu ft	pct
1.3/303.05-1	180	3.1	4.7	1	Undisturbed	ML	9.7	74.2	[illegible]	24	73.0	[illegible]	68.1	10.9*
		6.7	8.7	2	Undisturbed	ML	11.8	--	32	26	--	--	--	--
		9.1	10.1	3	Undisturbed	ML	10.9	77.6	36	28	78.8	10.4	--	--
		14.8	16.3	4	Undisturbed	ML	12.8	86.3	[illegible]		--	--	--	--
		19.2	20.8	5	Undisturbed	ML	14.1	85.0	36	27	[illegible]	[illegible]	[illegible]	14.8
		29.1	30.7	6	Undisturbed	ML	15.6	--	34	25	--	--	--	--
		41.2	42.6	7	Undisturbed	ML	10.6	84.7	34	28	--	--	--	--
1.3/303.07-1	230	3.2	4.8	1	Undisturbed	ML	9.7	--	[illegible]	29	--	--	--	--
		6.6	8.1	2	Undisturbed	ML	11.4	63.5	37	30	--	--	--	--
		9.1	11.0	3	Undisturbed	ML	11.2	69.7	35	27		--	--	--
		14.7	16.3	4	Undisturbed	ML	14.1	--	34	25		--	--	--
		20.2	21.8	5	Undisturbed	ML	14.7	86.8	46	27	--	--	--	--
		29.3	30.3	6	Undisturbed	ML	14.1	92.5	33	26	--	--	--	--
		39.2	40.9	7	Undisturbed	ML	13.1	--	34	26	--	--	--	--
1.3/303.09-1	280	[illegible]	4.3	1	Undisturbed	ML	9.5	71.8	30	24	70.2	10.3	72.1	11.5
		[illegible]	[illegible]	2	Undisturbed	ML	11.8	78.2	34	27	--	--	--	--
		9.1	10.6	3	Undisturbed	ML	13.3	74.6	33	27	--		--	--
		14.5	15.4	4	Undisturbed	ML	14.2	86.4	31	[illegible]	--	--	--	--
		19.7	20.7	5	Undisturbed	ML	14.7	86.6	37	25	87.7	[illegible]	[illegible]	14.9
		31.1	32.2	6	Undisturbed	ML	14.4	86.2	34	28	--	--	--	--
		39.0	40.3	7	Undisturbed	ML	15.2	86.4	31	26	--	--	--	--

* Specimen unsuitable for triaxial test.

TABLE 3.4 PROJECT 1.3, SUMMARY OF CONSOLIDATION TEST RESULTS ON UNDISTURBED NATURAL SOIL (PRETEST)

Specimen Location	Depth	Initial		Final		Specific Gravity*	Modulus of Deformation**			
							1st Cycle		2nd Cycle	
		w.c.	γ_d	w.c.	γ_d		50 psi	100 psi	50 psi	100 psi
	ft	pct	lb/ft^3	pct	lb/ft^3		psi	psi	psi	psi
Boring 1.3/503.05-1 Sample No. 1	3.1' to 4.7'	10.6	75.0	10.1	98.6	2.69	2,000	2,380	9,250	16,650
Boring 1.3/503.05-1 Sample No. 3	9.1' to 10.1'	10.4	78.8	10.1	97.6	2.69	1,610	2,130	8,340	1[illegible],300
Boring 1.3/503.05-1 Sample No. 5	19.0' to 19.2'	14.8	86.8	14.5	98.1	2.69	4,760	8,340	33,300	[illegible],300
Boring 1.3/503.09-1 Sample No. 1	3.0' to 4.3'	10.3	70.2	10.0	96.6	2.69	1,190	1,330	5,550	12,200
Boring 1.3/503.09-1 Sample No. 5	19.7' to 20.7'	14.6	87.7	14.2	98.2	2.69	11,700	11,700	16,600	16,600

*Estimated

**At stre[illegible] d in column heading.

TABLE [illegible] [illegible], WATER CONTENT AND DENSITY
OF [illegible] BACKFILL

Hole Location		Sample No.	Depth	γ_d	w.c.
Hole	Radial Distance from GZ				
	ft		ft-in.	lb/cu ft	pct
503.04-1	100	A-1	[illegible]'-8"	91.9	16.3
	100	A-2	14'-10"	86.7	18.2
	[illegible]	A-3	10'-3"	89.7	13.5
	100	A-4	6'-[illegible]"	84.5	14.4
	100	A-5	6'-7"	93.7	13.9
	100	A-6	3'-8"	69.6	13.7
503.08-1	300	B-1	17'-5"	88.0	17.2
	300	B-2	15'-0"	86.2	17.1
	300	B-3	12'-5"	86.4	17.1
	300	B-4	9'-8"	86.3	17.2
	300	B-5	7'-3"	86.6	17.2
	300	B-6	4'-8"	85.1	17.1
	300	B-7	3'-0"	87.3	17.6
	300	B-8	1'-7"	85.8	16.6

TABLE 3.6 PROJECT 1.3, SUMMARY OF SOIL PROPERTIES (POSTTEST)

Boring No.	Distance From GZ	Depth From	Depth To	Sample No.	Type of Sample	Laboratory Test: Classification	Liquid Limit	Plastic Limit	Consolidation γ_d	Consolidation w.c.	Triaxial γ_d	Triaxial w.c.
	ft	ft	ft						lb/cu ft	pct	lb/cu ft	pct
1.3/503.05-2	180	3.2	4.5	1	Undisturbed	ML	39	[illegible]	[illegible]	10.6	75.4	[illegible]
		9.0	10.8	2	Undisturbed	ML	44	29	[illegible]	13.5	72.5	12.1
		19.0	20.4	3	Undisturbed	ML	35	26	[illegible]	14.9	86.1	15.4

TABLE 3.? PROJECT 1.3, SUMMARY OF CONSOLIDATION TEST RESULTS ON UNDISTURBED SOIL (POSTTEST)

Specimen Location	Depth	Initial w.c.	Initial γ_d	Final w.c.	Final γ_d	Specific Gravity	Modulus of Deformation* 1st Cycle 50 psi	1st Cycle 100 psi	2nd Cycle 50 psi	2nd Cycle 100 psi
	ft	pct	lb/cu ft	pct	lb/cu ft		psi	psi	psi	psi
Boring 1.3/503.05-2 Sample 1	3.2 to 4.5	10.6	73.7	9.9	97.1	2.70	2,660	2,960	13,650	[illegible]4,820
Boring 1.3/503.05-2 Sample 2	9.0 to 10.8	13.[illegible]	74.3	12.8	95.0	2.70	2,860	3,200	7,400	13,340
Boring 1.3/503.05-2 Sample 3	19.0 to	14.9	87.3	14.3	99.4	2.70	8,[illegible]00	10,000	2,920	14,810

*At stress stated in column heading

TABLE 3.8 PROJECT 3.1, WATER CONTENT AND DENSITY OF SAND BACKFILL

Structure Pit Location Station	Structure Pit Location from GZ	Pit No.	Sample No.	γ_d	w.c.
	ft			lb/cu ft	pct
514.05	265	1	1A	[illegible]	0.3
514.06	290	2	2A	[illegible]	0.4
514.01	320	3	3A	[illegible]	0.3
514.01	320		3B	[illegible]	0.3
514.02	365	4	4A	100.5	0.3
514.02	365		4B	101.4	0.4
514.03	420	5	5A	101.1	0.5
514.03	420		5B	102.0	0.3
514.07	445	6	6A	98.2	[illegible]
514.07	445		6B	101.6	0.4
514.07	445		6C	101.8	0.4
514.08	525	7	7A	99.5	0.3
514.08	525		7B	98.3	0.4
514.04	630	8	8A	[illegible]	[illegible]
514.04	630		8B	102.0	0.3

TABLE [illegible] PROJECT [illegible], SUMMARY OF SOIL PROPERTIES

Sample No.	Location	Depth ft	Type of Sample	Type of Test	Percent Passing [illegible] Sieve Pct	Atterberg Limits LL Pct	Atterberg Limits PL Pct	Atterberg Limits PI Pct	Soil Class.	Sp. Gr.	Initial Condition Void Ratio	Initial Condition Saturation	Initial Condition Natural Water Content	Initial Condition Nat. Dry Den. pcf	Shear Strength[1] tsf	Cohesion c tsf	Friction Angle φ Degrees
STATION [illegible], WALL FOOTING STRUCTURE																	
1A	Test Pit No. 1	5.0	--	Fld. Den.					ML				8.[illegible]	76.0			
1B	Test Pit No. 1	5.0	--	Fld. Den.					ML				9.3	82.0			
[illegible]A	Test Pit No. [illegible]	[illegible]	--	Fld. Den.					ML				9.1	70.5			
[illegible]B	Test Pit No. [illegible]	[illegible]	--	Fld. Den.					ML				10.[illegible]	71.4			
5A	Floor of Excav.	[illegible]	--	Fld. Den.					ML				9.[illegible]	73.0			
5B	Floor of Excav.	[illegible]	--	Fld. Den.					ML				8.[illegible]	[illegible]			
U1-1	Boring U1	[illegible].0	Dist.	Lab. Class.	[illegible]	[illegible]	[illegible]	[illegible]	ML	[illegible]							
U1-1	Boring U1	[illegible]	Undist.	Uncon. Comp.					ML		[illegible]	[illegible].6	[illegible]	[illegible]	0.[illegible]		
U1-1	Boring U1	[illegible]	Undist.	Triaxial					ML		1.[illegible]	[illegible]	[illegible]	70.1		[illegible]	30
U1-1	Boring U1		Undist.	Consol.					ML		1.[illegible]	[illegible]	14.6	75.9			
[illegible]	Boring U1	[illegible]	Dist.	Fld. Class.		[illegible]	[illegible]	[illegible]	ML				[illegible]				
U1-[illegible]	Boring U1	14.[illegible]	Dist.	Lab. Class.	[illegible]	[illegible]	[illegible]		ML								
[illegible]	[illegible]	[illegible]	Undist.	Uncon. Comp.					ML		1.[illegible]	[illegible]	14.6	[illegible]	1.37		
[illegible]	Boring U1		[illegible]	Triaxial					ML		1.[illegible]	[illegible]	[illegible]	[illegible]		[illegible]	32
[illegible]	Boring U1		Undist.	Consol.					ML		1.[illegible]	[illegible]	14.[illegible]	81.8			
U1-[illegible]A	Boring U1	15.[illegible]	Dist.	Fld. Class.		[illegible]	[illegible]	[illegible]	ML				14.6				
[illegible]	[illegible]	[illegible]	Dist.	Lab. Class.	[illegible]	[illegible]	[illegible]	[illegible]	ML								
[illegible]	Boring U2		Undist.	Uncon. Comp.					ML		1.[illegible]	[illegible].8	11.6	76.1	[illegible].10		
[illegible]	[illegible]		Undist.	Triaxial					ML		1.[illegible]	[illegible]	[illegible]	[illegible]		1.0	[illegible]
[illegible]	[illegible]		Undist.	Consol.					ML		1.34	16.[illegible]	8.0	[illegible]			
[illegible]	[illegible]	[illegible]	Dist.	Fld. Class.		[illegible]	[illegible]		ML				11.9				
[illegible]	Boring U2	14.[illegible]	Dist.	Lab. Class.	[illegible]	[illegible]	[illegible]	[illegible]	ML	[illegible]							
[illegible]	[illegible]	[illegible]	Undist.	Uncon. Comp.					ML		1.[illegible]	[illegible]	13.5	[illegible]	1.[illegible]		
[illegible]	Boring U2	15.[illegible]	Undist.	Triaxial					ML		[illegible]	[illegible]	14.2	79.[illegible]		0.9	34
[illegible]	Boring U2		Undist.	Consol.					ML		1.05	35.9	13.8	[illegible]			
[illegible]	Boring U2	15.[illegible]	[illegible]	Fld. Class.		[illegible]	[illegible]	[illegible]	ML								
STATION [illegible], INTERIOR FOOTING STRUCTURE																	
3A	Test Pit No. [illegible]	5.0	--	Fld. Den.					ML				8.4	[illegible]			
3B	Test Pit No. 3	[illegible]	--	Fld. Den.					ML				[illegible]	67.6			
4A	Test Pit No. 4	[illegible]	--	Fld. Den.					ML				11.4	72.0			
4B	Test Pit No. 4	5.0	--	Fld. Den.					ML				11.3	71.9			
6A	Floor of Excav.	[illegible].6	--	Fld. Den.					ML				14.6	69.[illegible]			
6B	Floor of Excav.	[illegible].6	--	Fld. Den.					ML				10.6	[illegible]			
[illegible]	Floor of Excav.	[illegible]	--	Fld. Den.					ML				[illegible]	[illegible]			
[illegible]	[illegible]	[illegible]	--	Fld. Den.					ML				[illegible]	[illegible]			
[illegible]	Boring U3A	[illegible]	Dist.	Lab. Class.	[illegible]	[illegible]	[illegible]	[illegible]	ML	[illegible]							
[illegible]	Boring U3A	[illegible]	Undist.	Triaxial					ML		[illegible]	[illegible]	[illegible]	[illegible]	(2)	1.0	[illegible]
[illegible]	Boring U3A	[illegible]	Undist.	Consol.					ML		1.[illegible]	[illegible]	[illegible]	[illegible]			
[illegible]	Boring [illegible]	[illegible]	Dist.	Fld. Class.		[illegible]	[illegible]	[illegible]	[illegible]				14.0				
[illegible]	Boring [illegible]	[illegible]	Dist.	Lab. Class.	[illegible]	[illegible]	[illegible]	[illegible]	ML								
[illegible]	Boring [illegible]	[illegible]	Undist.	Uncon. Comp.					ML		0.[illegible]	[illegible]	[illegible]	[illegible]	[illegible]		
[illegible]	Boring [illegible]	[illegible]	Undist.	Triaxial					ML		1.[illegible]	[illegible]	[illegible]	[illegible]		[illegible]	[illegible]
[illegible]	Boring [illegible]		Undist.	Consol.					ML		1.[illegible]	[illegible]	[illegible]	[illegible]			
[illegible]	Boring [illegible]	[illegible]	Dist.	Fld. Class.		[illegible]		[illegible]	ML				[illegible]				
[illegible]	Boring [illegible]	[illegible]	Dist.	Lab. Class.	[illegible]	[illegible]	[illegible]	[illegible]	ML								
[illegible]	Boring [illegible]	[illegible]	Undist.	Uncon. Comp.					ML		[illegible]	[illegible]	[illegible]	[illegible]	[illegible]		
[illegible]	Boring [illegible]	[illegible]	Undist.	Triaxial					ML		1.[illegible]	[illegible]	[illegible]	[illegible]		[illegible]	[illegible]
[illegible]	Boring [illegible]		Undist.	Consol.					ML		1.[illegible]	[illegible]	[illegible]	[illegible]			
[illegible]	Boring [illegible]	[illegible]	Dist.	Fld. Class.		[illegible]	[illegible]	[illegible]	ML				[illegible]				
[illegible]	Boring [illegible]	[illegible]	Dist.	Lab. Class.	[illegible]	[illegible]	[illegible]	[illegible]	ML	[illegible]							
[illegible]	Boring [illegible]	[illegible]	Undist.	Consol.					ML		[illegible]	[illegible]	[illegible]	[illegible]	(2)	[illegible]	(2)
[illegible]	Boring [illegible]	[illegible]	Dist.	Fld. Class.		[illegible]	[illegible]	[illegible]	[illegible]								

NOTES: (1) Shear strength is [illegible].
(2) [illegible] additional sample was not available for test.

TABLE 3.10 PROJECT 3.2, WATER CONTENT AND DENSITY OF SILT BACKFILL FOR WALL FOOTING STRUCTURE, STA 515.01

Location	Depth*	w.c.	Wet Density	Dry Density
	ft	pct	lb/cu ft	lb/cu ft
NW Corner	-7.9	19.2	110.8	92.9
NE Corner	-7.9	19.4	119.0	99.7
SE Corner	-7.5	25.2	113.3	90.[illegible]
NW Corner	-6.4	20.1	112.8	94.0
NE Corner	-6.4	20.8	120.6	99.9
SW Corner	-5.4	[illegible].9	107.[illegible]	88.2
SE Corner	-5.4	23.3	116.8	94.5
S Middle	-5.3	24.4	110.1	88.4
NW Corner	-5.2	18.8	111.4	93.5
NE Corner	-5.2	17.9	111.2	94.3
SW Corner	-4.9	20.1	118.0	98.4
SE Corner	-4.9	19.7	113.8	95.4
NW Corner	-4.4	20.7	110.6	91.8
NE Corner	-4.4	21.2	115.0	94.8
SW Corner	-3.9	20.0	123.6	103.3
SE Corner	-3.9	21.3	121.0	99.8
NW Corner	-3.7	19.2	119.6	100.1
NE Corner	-3.7	19.7	120.0	100.1
NW Corner	-2.8	19.2	108.0	90.5
NE Corner	-2.8	19.4	115.6	96.6
SE Corner	-2.3	20.8	120.2	99.5
SW Corner	-1.8	20.6	112.7	93.5
NW Corner	-1.5	19.4	110.6	92.5
NE Corner	-1.5	19.6	105.9	88.5
SW Corner	-1.1	16.3	106.4	91.7
SE Corner	-1.1	15.9	98.8	85.0
NW Corner	-0.9	20.8	110.0	91.0
NE Corner	-0.9	21.8	112.4	92.5
SW Corner	-0.7	22.1	118.8	97.3
SE Corner	-0.7	21.3	115.6	95.2

*Depth below original ground surface

TABLE 3.11 PROJECT 3.2, WATER CONTENT AND DENSITY OF SILT BACKFILL AROUND INTERIOR FOOTING STRUCTURE, STA 515.02

Location	Depth*	w.c.	Wet Density	Dry Density
	ft	pct	lb/cu ft	lb/cu ft
SE Corner	-1.8	19.6	108.3	90.[illegible]
NW Corner	-1.6	20.9	103.3	85.5
N Middle	-1.8	20.2	110.1	91.5
SW Corner	-1.2	21.8	114.4	94.2
NE Corner	-1.2	21.0	111.8	92.5
NW Corner	-1.2	21.0	113.6	93.8
SE Corner	-1.2	20.3	107.2	89.0
NE Corner	-1.0	16.2	110.0	94.8
SW Corner	-1.0	17.8	105.6	89.6
SE Corner	-0.3	17.9	103.4	87.8
SW Corner	-0.3	17.4	101.0	86.0
NE Corner	-0.3	18.1	99.8	84.3
NW Corner	-0.2	18.7	98.1	82.5
SW Corner	+1.0	17.6	100.8	85.9
SE Corner	+1.0	16.2	98.0	84.3
NE Corner	+1.0	16.1	100.0	86.2
NW Corner	+1.0	17.4	100.6	85.5
NW Corner	Grade	17.4	103.8	88.5
SW Corner	Grade	16.9	104.8	89.7
Center	Grade	17.5	103.8	88.5
SE Corner	Grade	18.7	102.2	86.3
NE Corner	Grade	18.2	104.4	88.5

*Depth below (-) or above (+) original ground surface

TABLE 3.12 PROJECT 3-3, WATER CONTENT AND DENSITY OF SAND BACKFILL

Structure Pit Location: Station	Structure Pit Location: Radial Distance from GZ	Pit No.	Sample No.	Footing Level: Wet Density	Footing Level: Dry Density	Footing Level: w.c.	Ground Surface: Wet Density	Ground Surface: Dry Density	Ground Surface: w.c.
	ft			lb/cu ft	lb/cu ft	pct	lb/cu ft	lb/cu ft	pct
516.01	920	1	1A	114.0	112.5	1.4	114.3	112.1	1.9
			1B	111.6	109.9	1.6	115.2	112.8	2.2
			1C	115.5	113.6	1.7	115.4	113.1	2.0
			1D	115.5	113.9	1.4	115.4	113.2	2.0
516.02	1160	2	2A	112.5	111.0	1.3	114.5	112.7	1.6
			2B	113.5	112.1	1.2	115.1	113.2	1.7
			2C	113.7	112.0	1.5	114.0	112.0	1.8
			2D	113.9	112.2	1.5	113.5	111.6	1.7
516.02	1160	3	3A	110.6	109.1	1.4	113.2	111.2	1.8
			3B	113.7	112.0	1.5	114.9	112.7	1.9
			3C	112.7	111.0	1.5	115.0	113.1	1.7
			3D	114.4	112.7	1.5	113.0	111.1	1.7
516.03	1400	4	4A	111.5	109.9	1.5	111.5	109.8	1.6
			4B	112.9	111.3	1.4	108.8	107.1	1.5
			4C	114.3	112.7	1.4	113.1	111.4	1.5
			4D	111.7	110.2	1.3	113.4	111.7	1.5
516.03	1400	5	5A	114.2	112.4	1.5	110.9	109.1	1.7
			5B	111.5	110.0	1.5	111.6	109.9	1.5
			5C	116.8	115.0	1.6	110.5	108.8	1.5
			5D	115.9	114.1	1.6	110.9	109.2	1.5
516 [illegible]	1900	6	6A	113.9	111.7	1.9	110.0	108.0	1.9
			6B	110.9	109.0	1.7	110.3	108.2	2.0
			6C	115.3	113.1	2.0	113.5	111.4	1.9
			6D	114.5	112.4	1.9	112.7	110.6	1.8

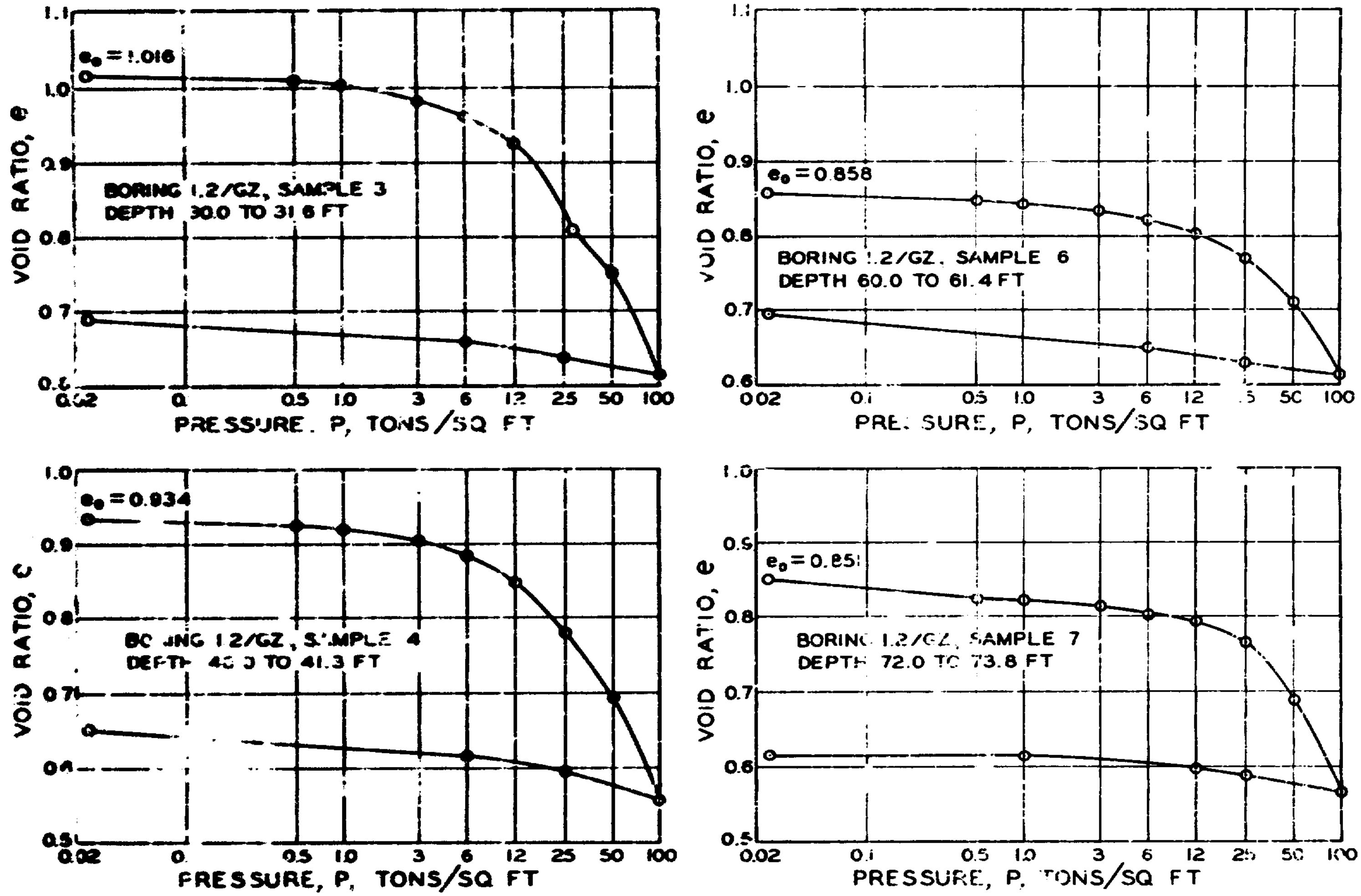


Figure 3.1 Project 1.2, pressure-void ratio, Samples 3, 4, 6, and 7.

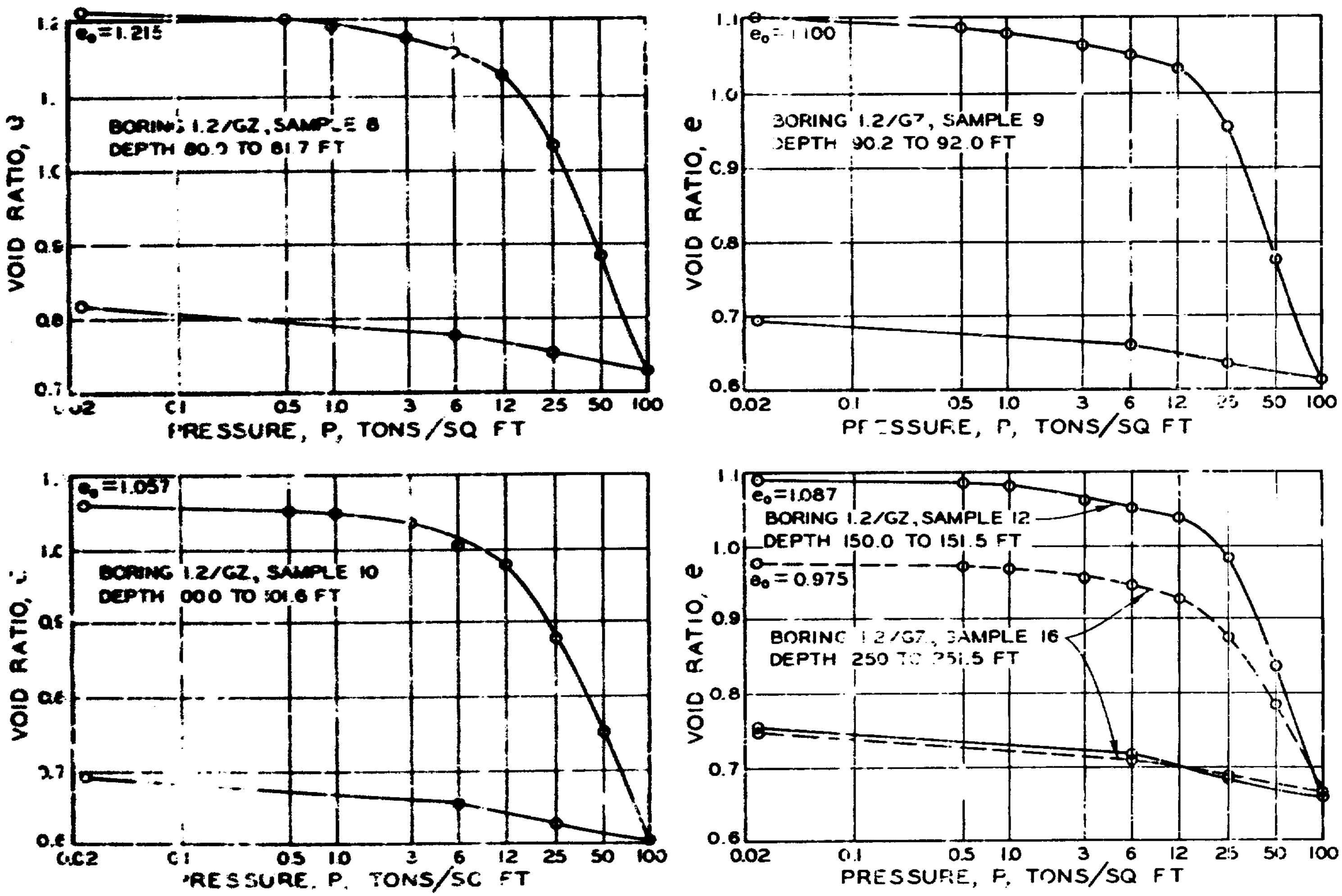


Figure 3.2 Project 1.2 pressure-void ratio, Samples 6, 9, 10, 12, and 16.

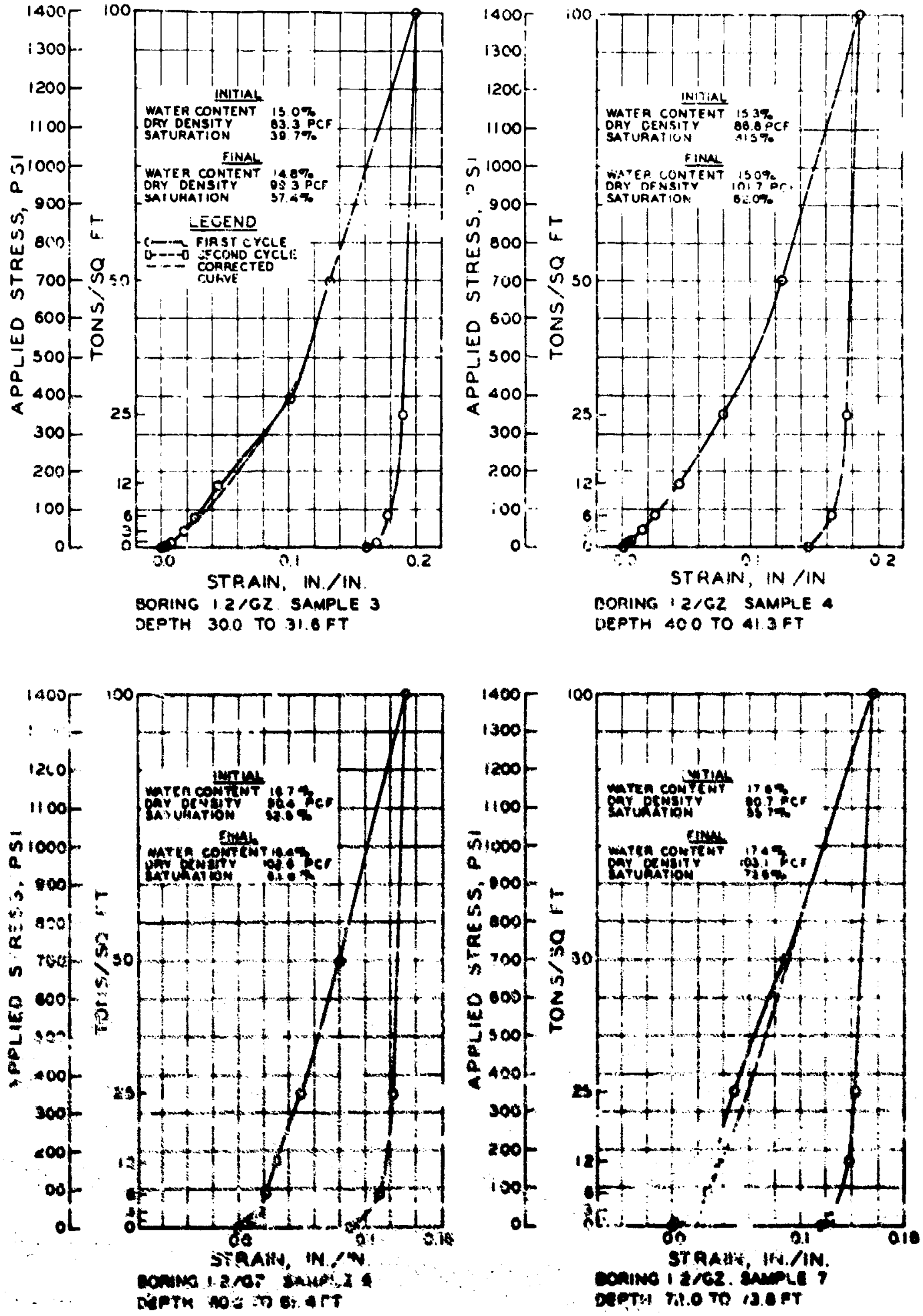


Figure 3.3 Project 1.2, consolidation tests, stress versus strain, samples 3, 4, 6, and 7.

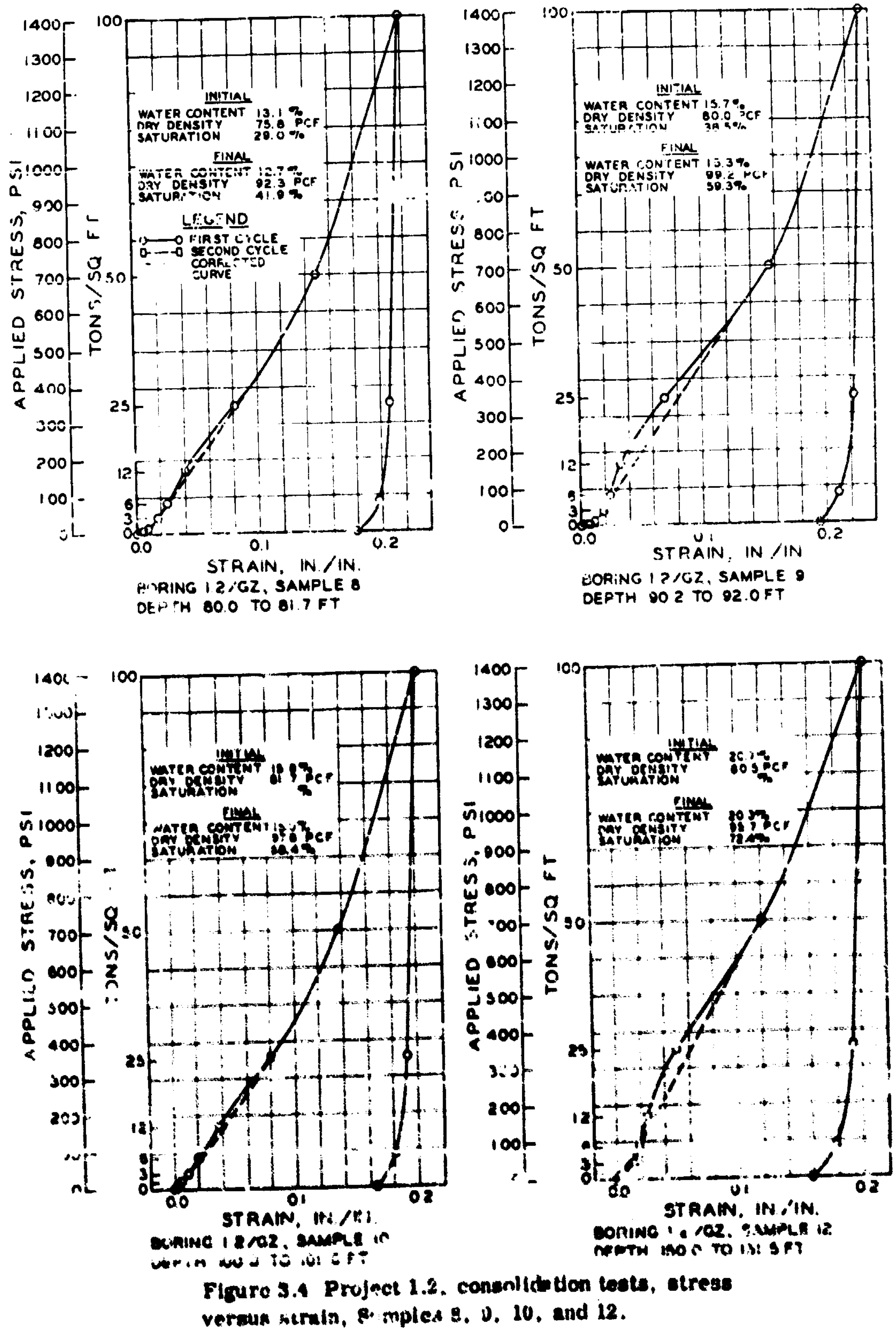


Figure 3.4 Project 1.2, consolidation tests, stress versus strain, Samples 8, 9, 10, and 12.

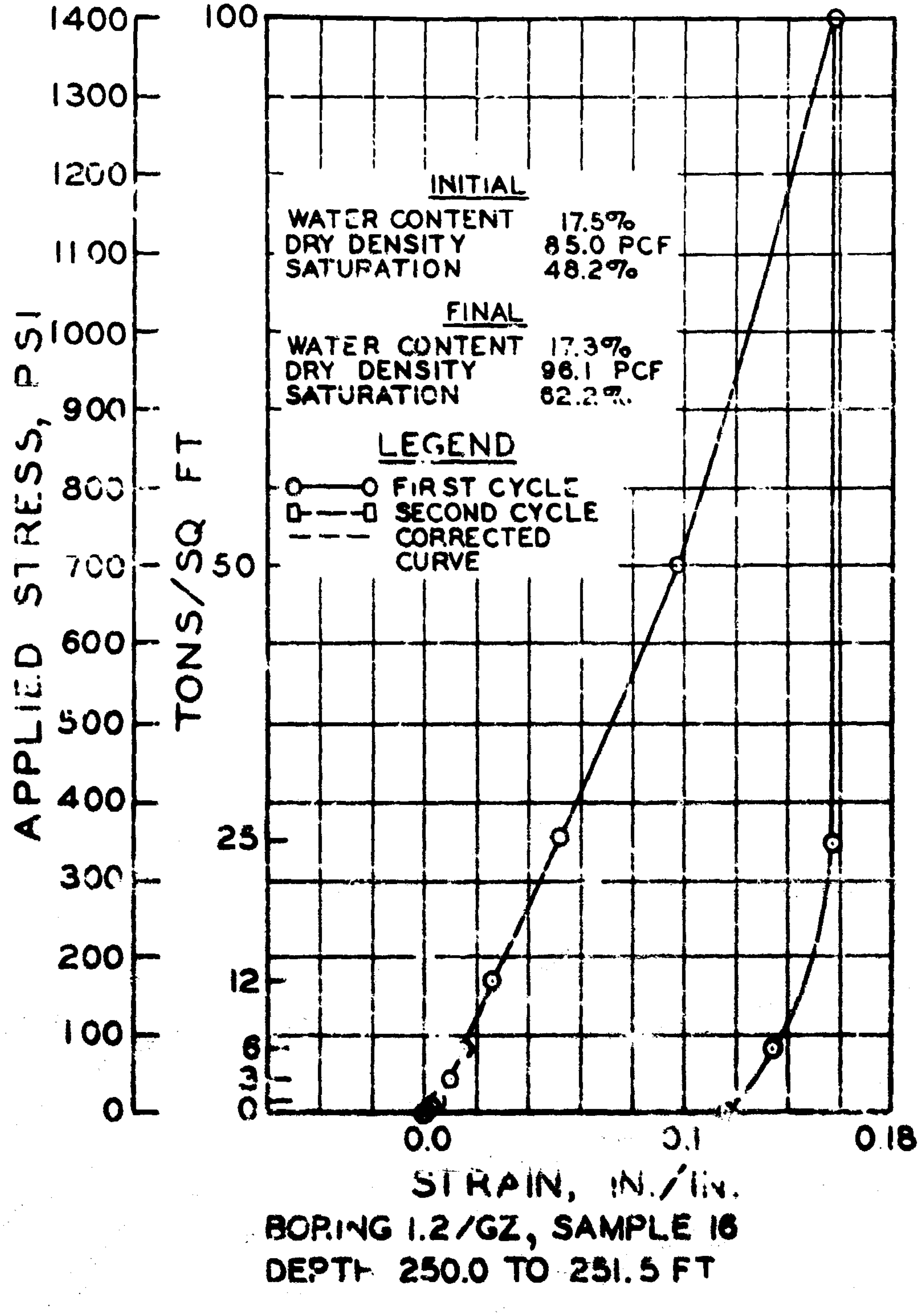


Figure 3.5 Project 1.2, consolidation tests, stress versus strain, Sample 16.

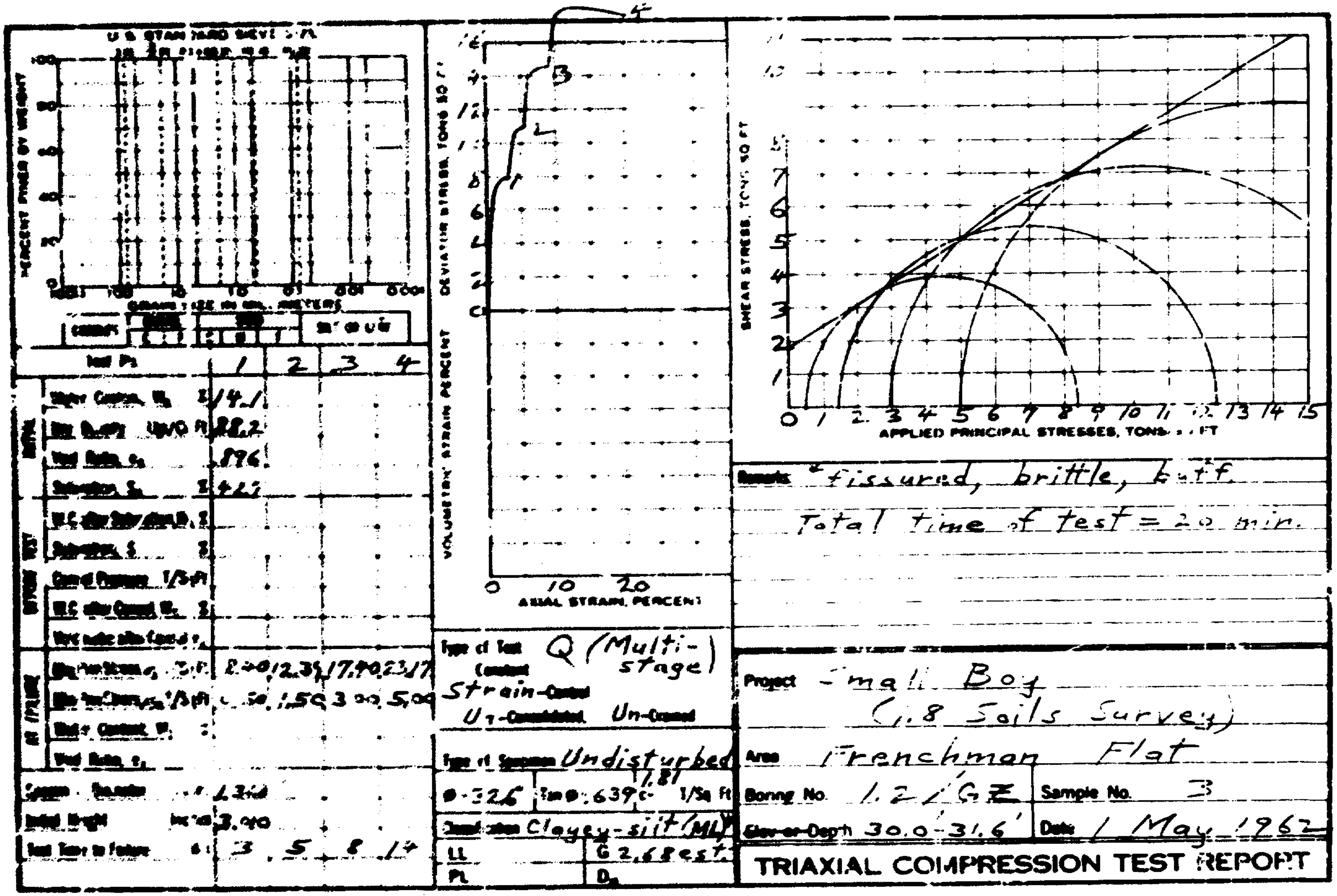


Figure 3.6 Project 1.2, multiple-stage triaxial test, boring 1.2/GZ, Sample 3.

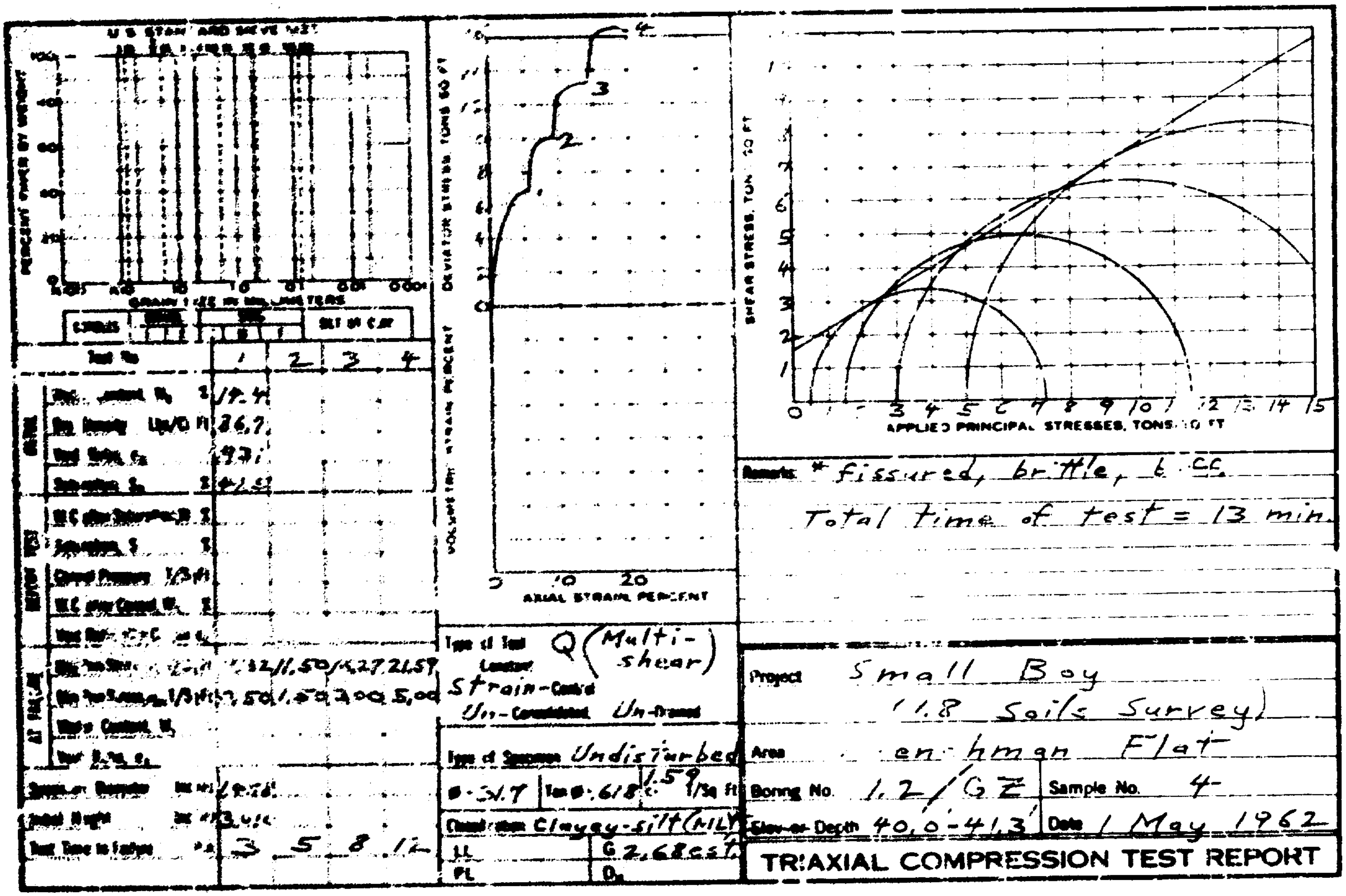


Figure 3.7 Project 1.2, multiple-stage triaxial test, boring 1.2/GZ. Sample 4.

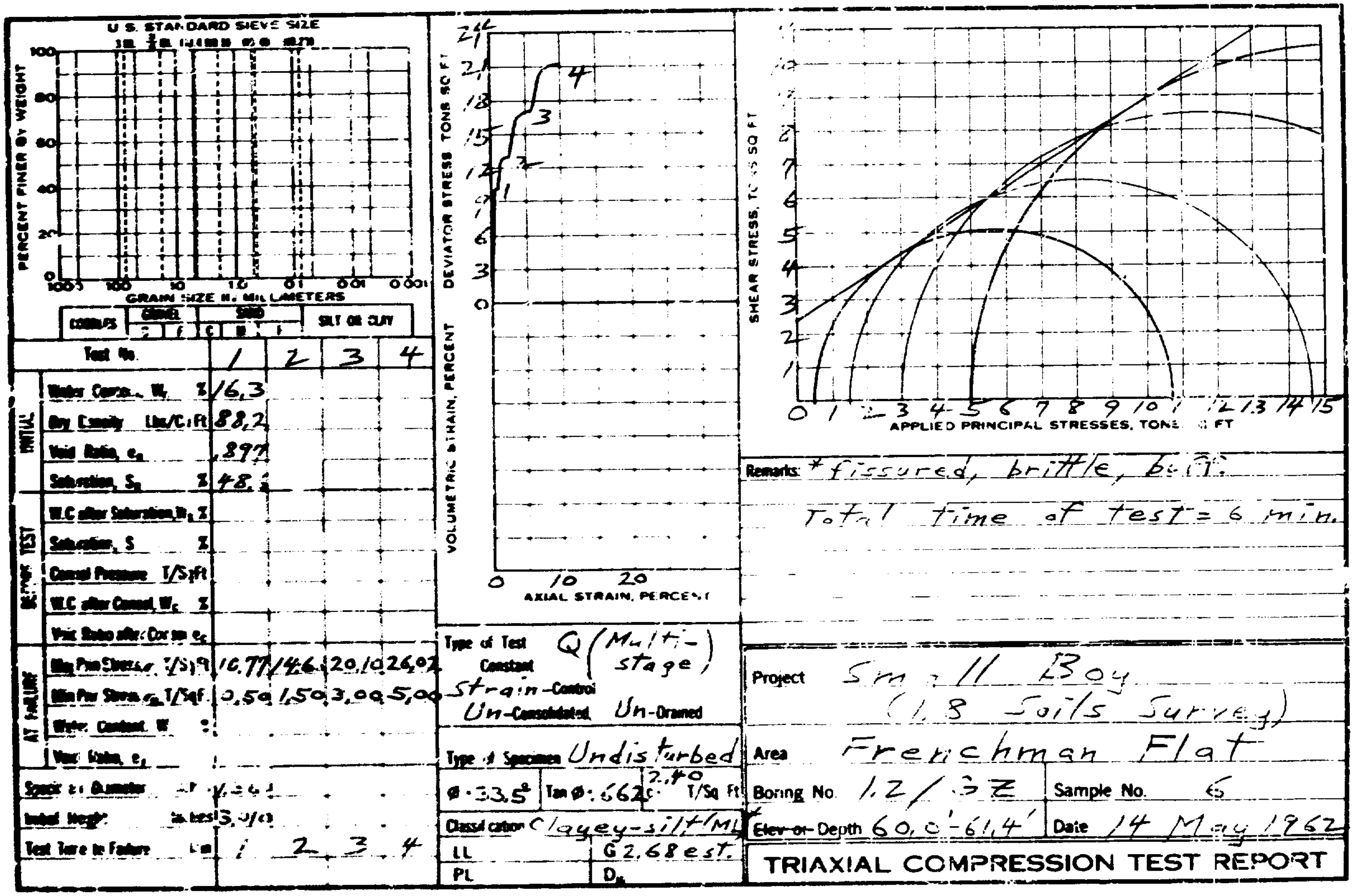


Figure 3.8 Project 1.2, multiple-stage triaxial test, boring 1.2/CZ, Sample 6.

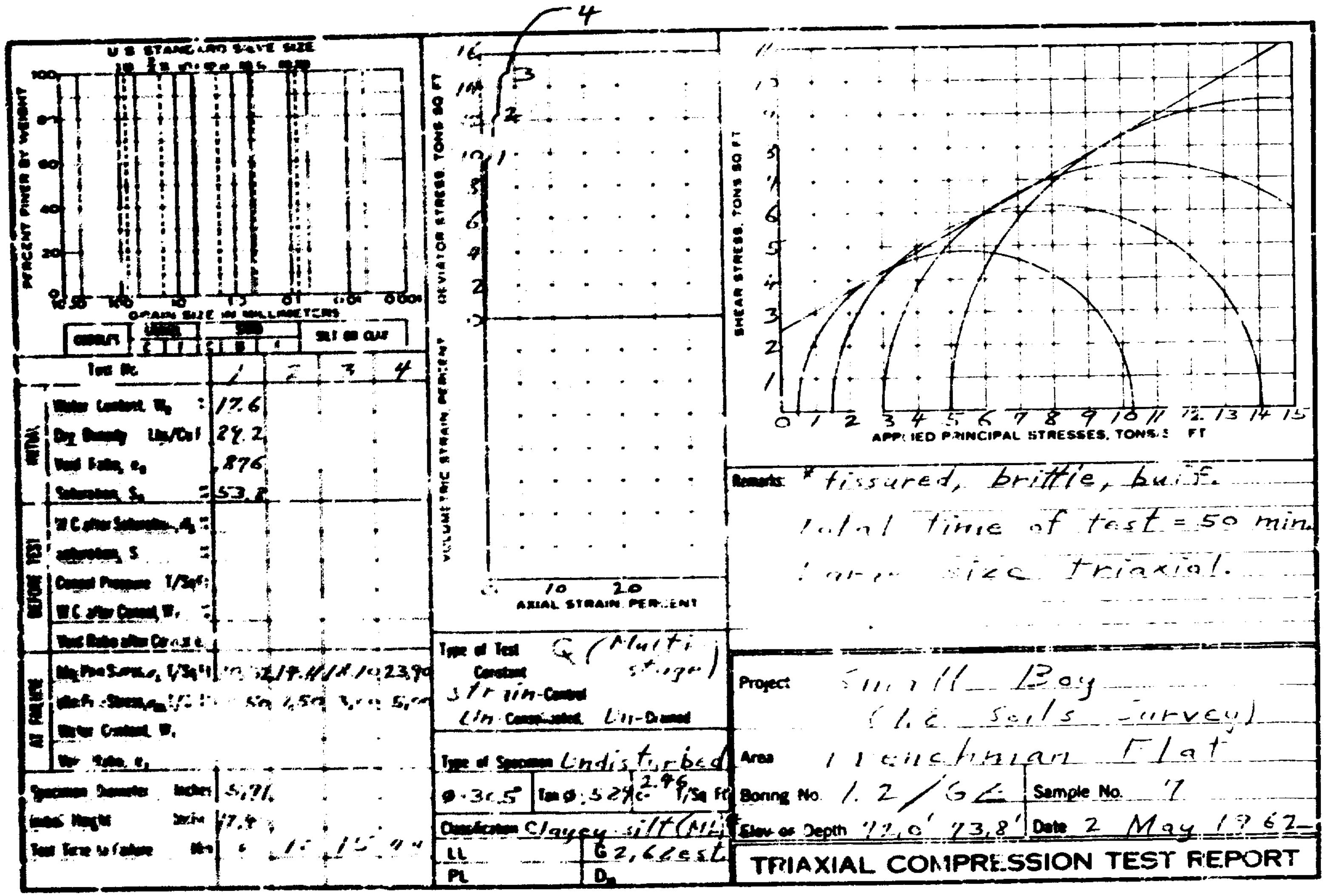


Figure 3.9 Project 1.2, multiple-stage triaxial test, boring 1.2/GZ, Sample 7.

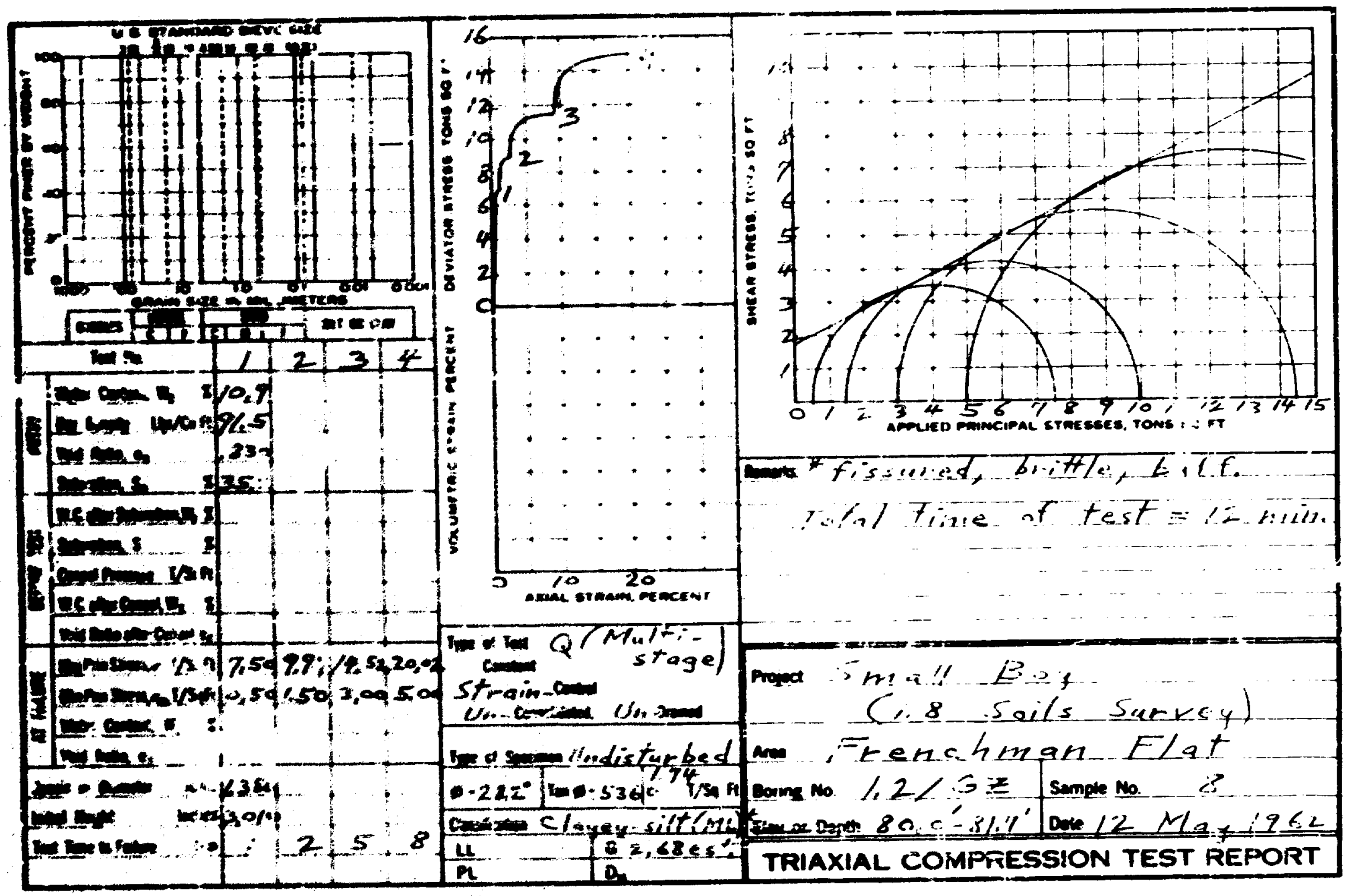


Figure 3.10 Project 1.2, multiple-stage triaxial test, boring 1.2/GZ, Sample 8.

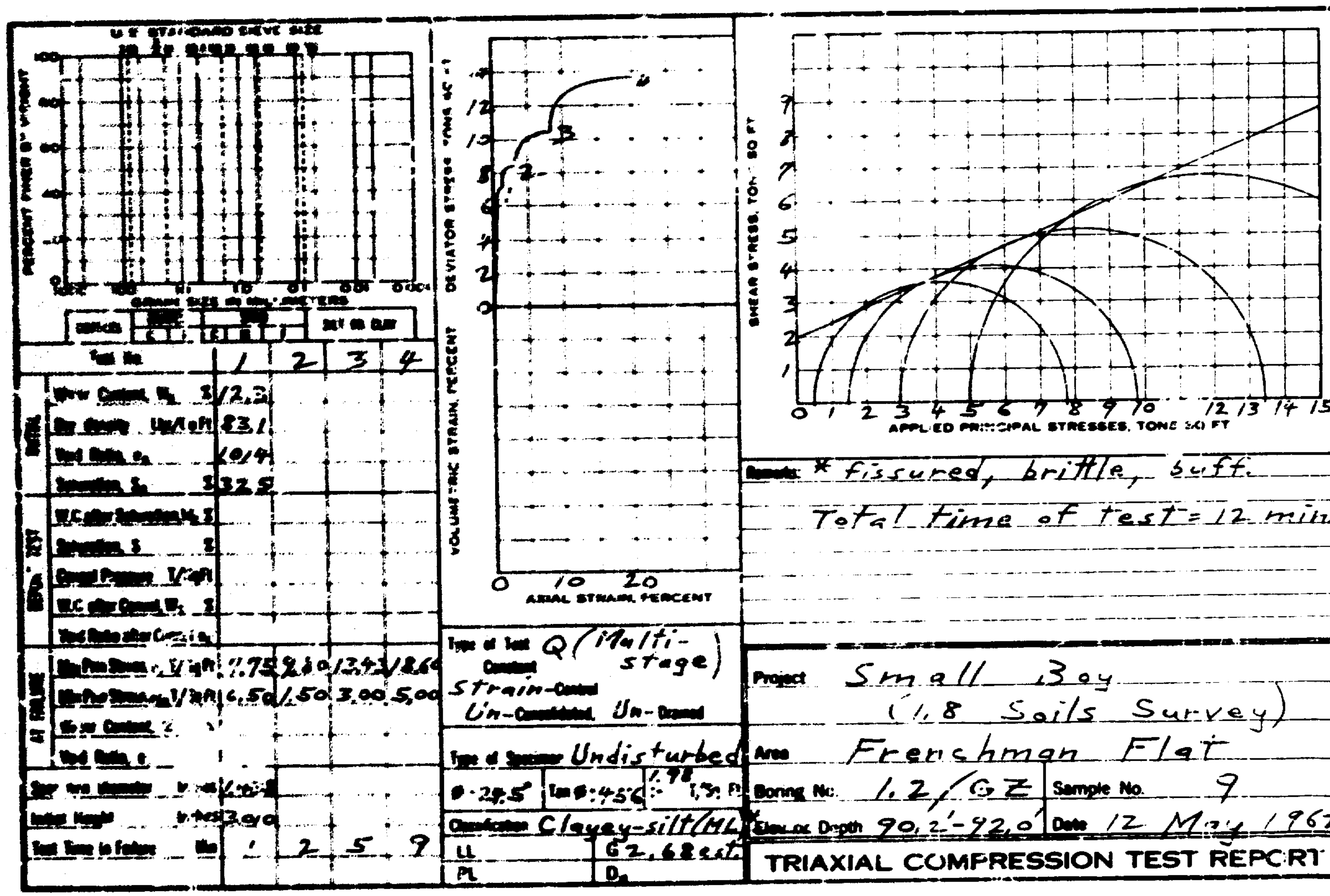


Figure 3.11 Project 1.2, multiple-stage triaxial test, boring 1.2/GZ, Sample 9.

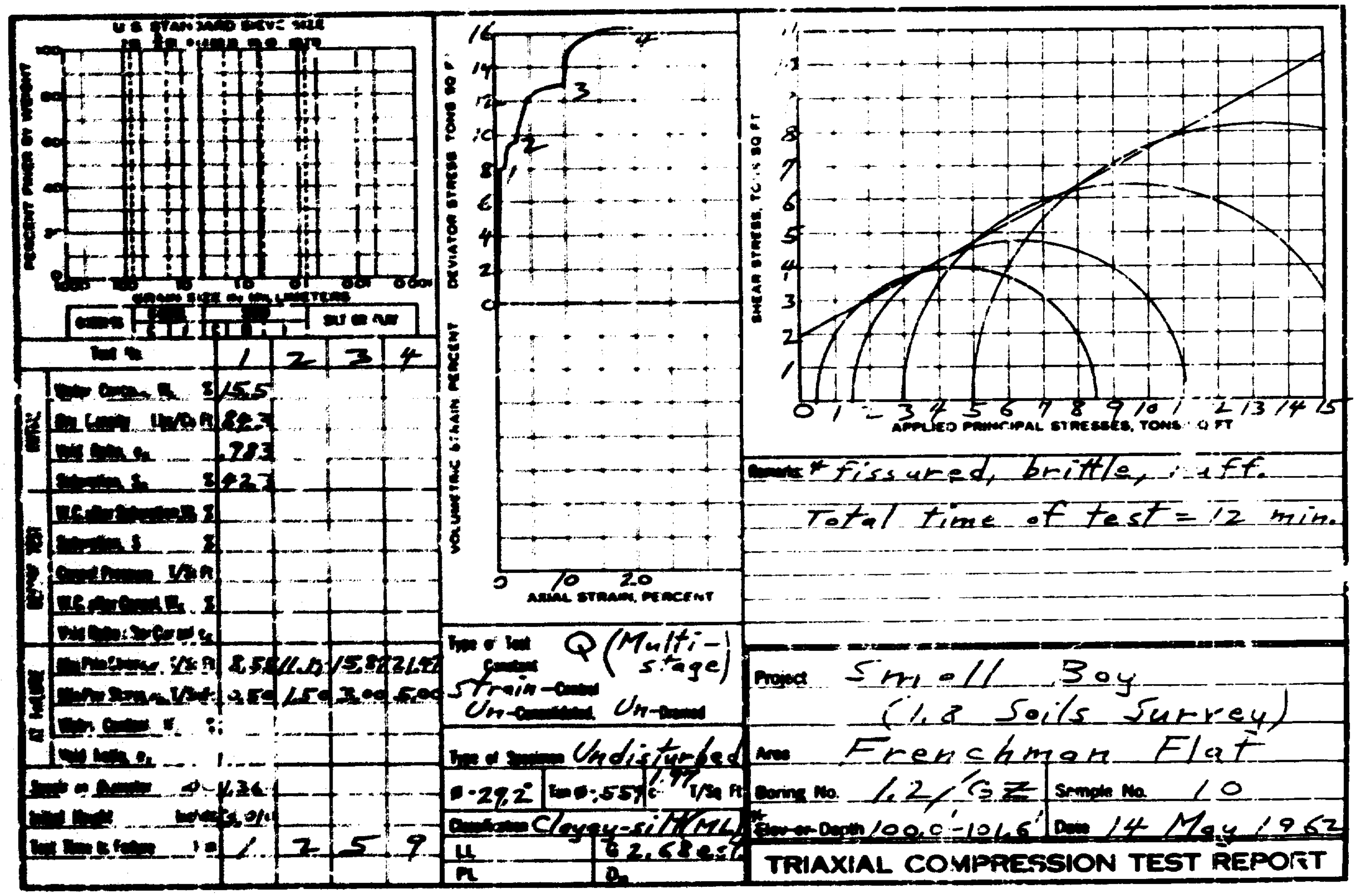


Figure 3.12 Project 1.2, multiple-stage triaxial test, boring 1.2/GZ, Sample 10.

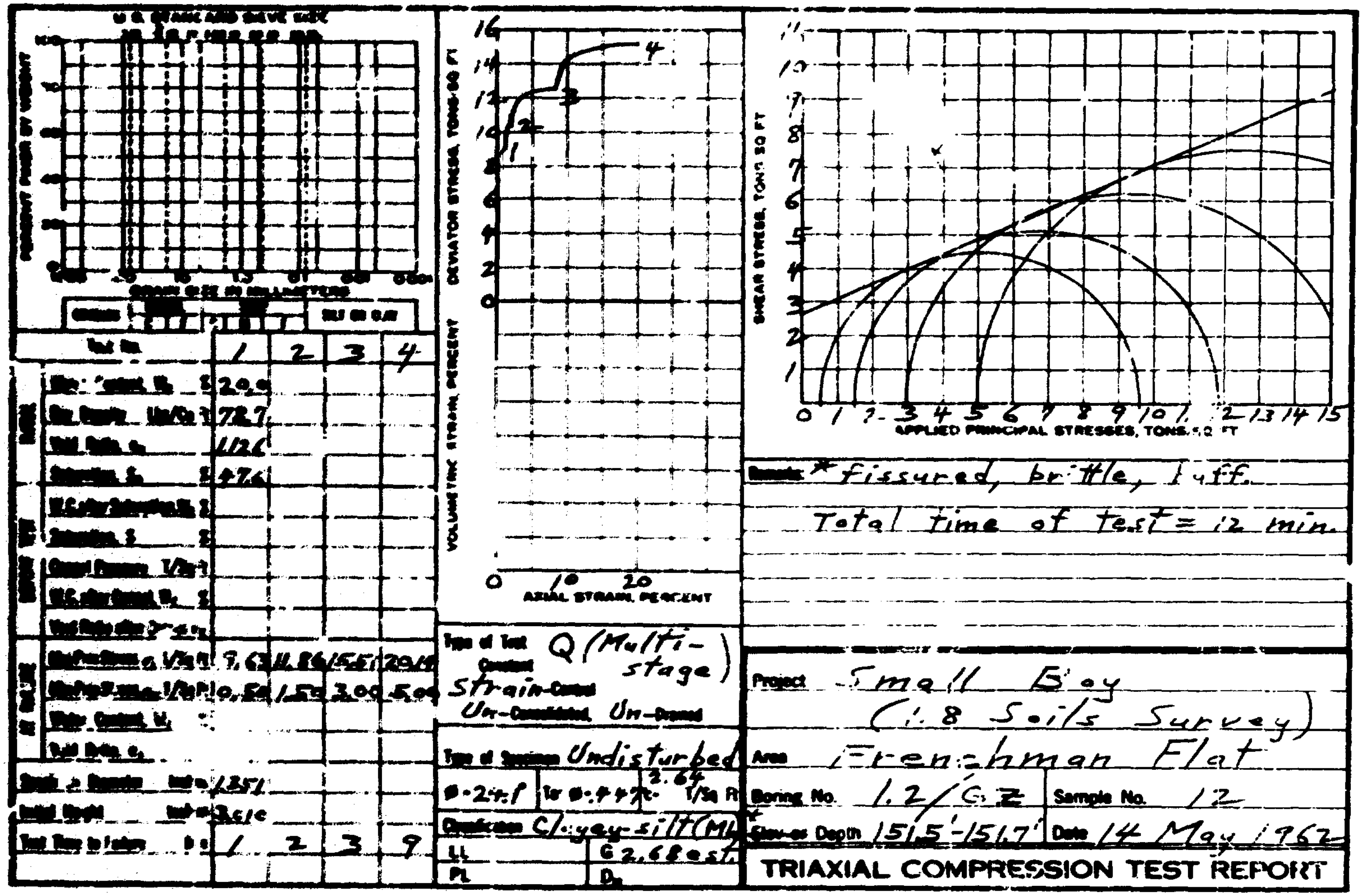


Figure 3.13 Project 1.2, multiple-stage triaxial test, boring 1.2/GZ, Sample 12.

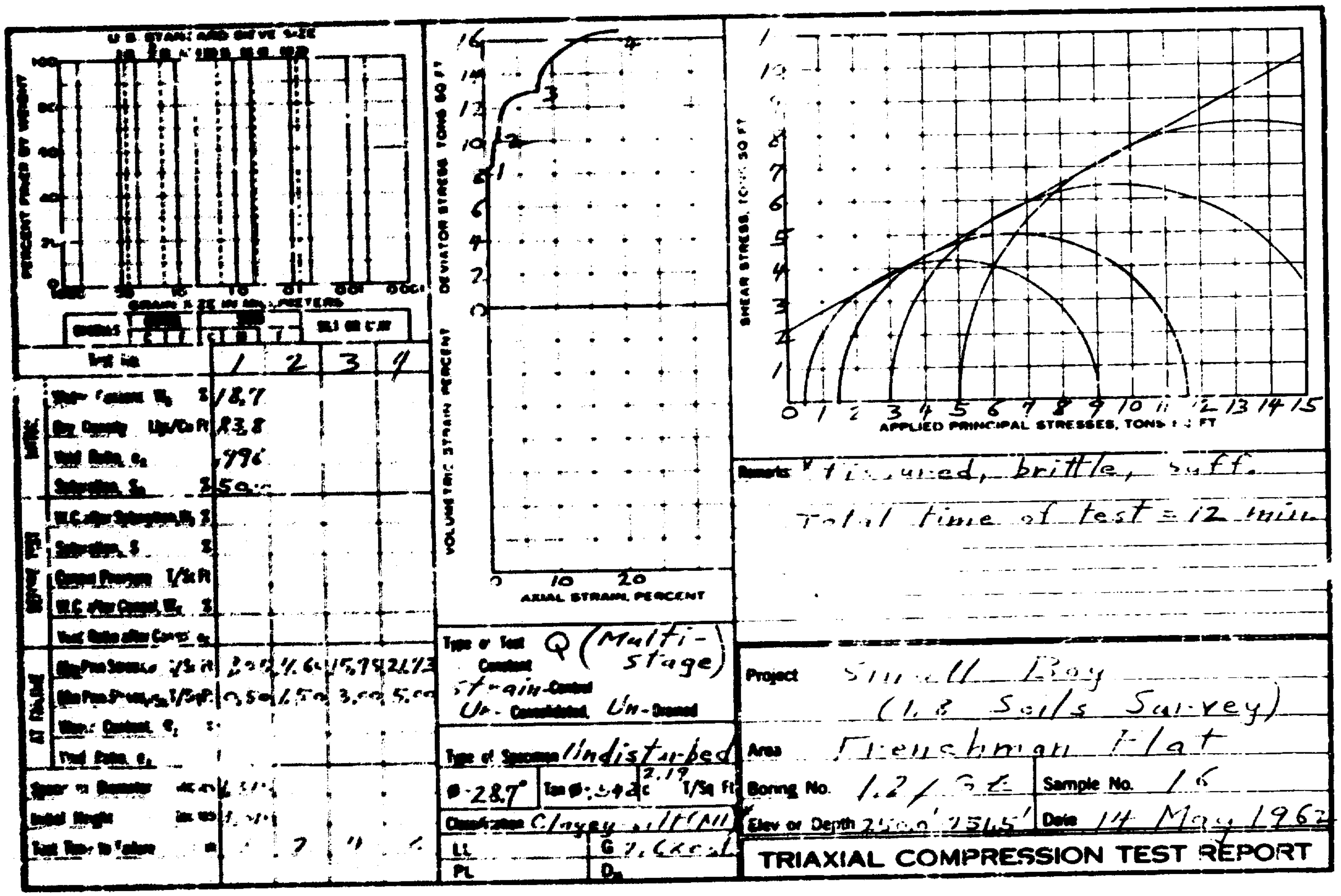


Figure 3.14 Project 1.2, multiple-stage triaxial test, boring 1.2/GZ, Sample 16.

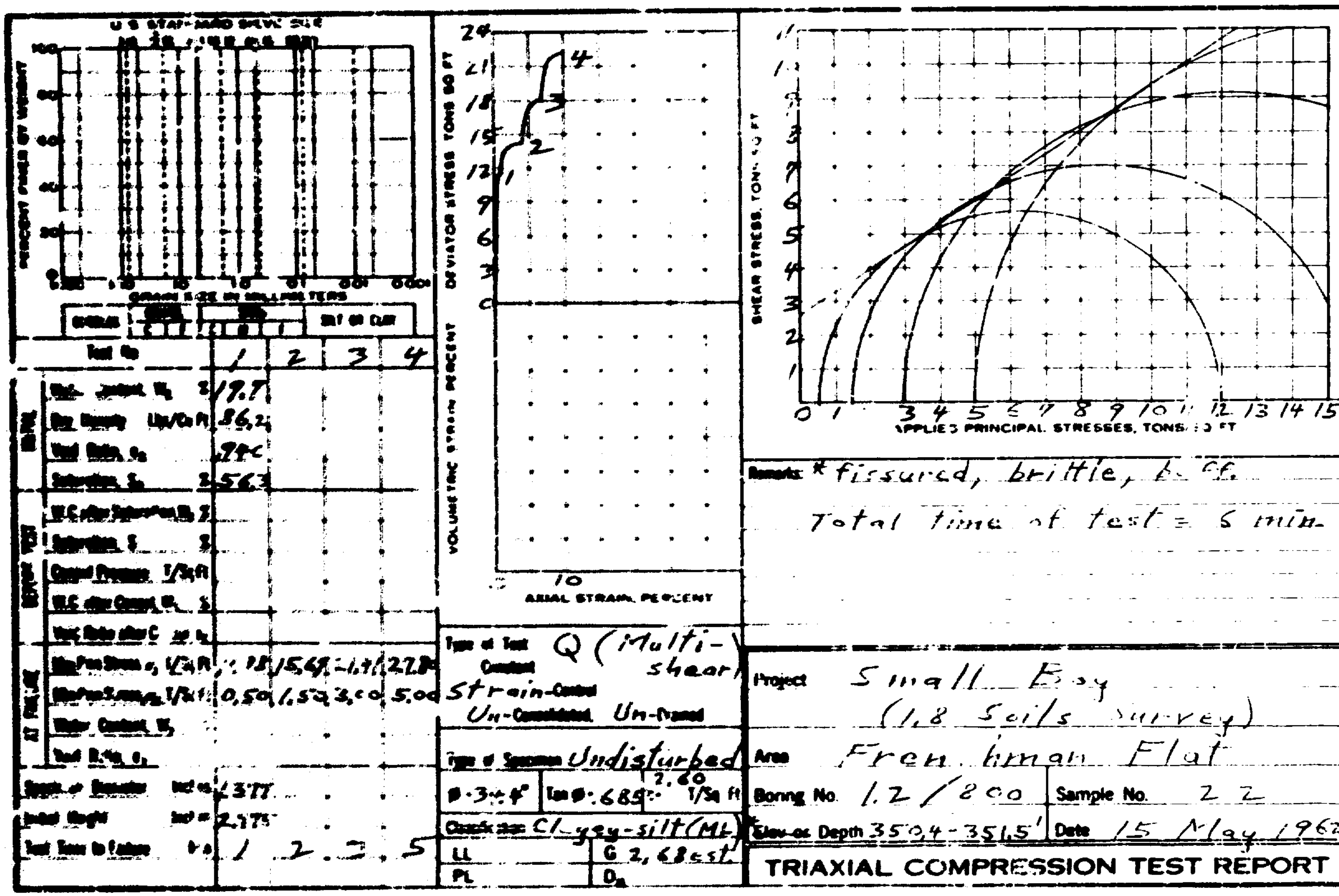


Figure 3.15 Project ..2, multiple-stage triaxial test, boring 1.2/800, Sample 22.

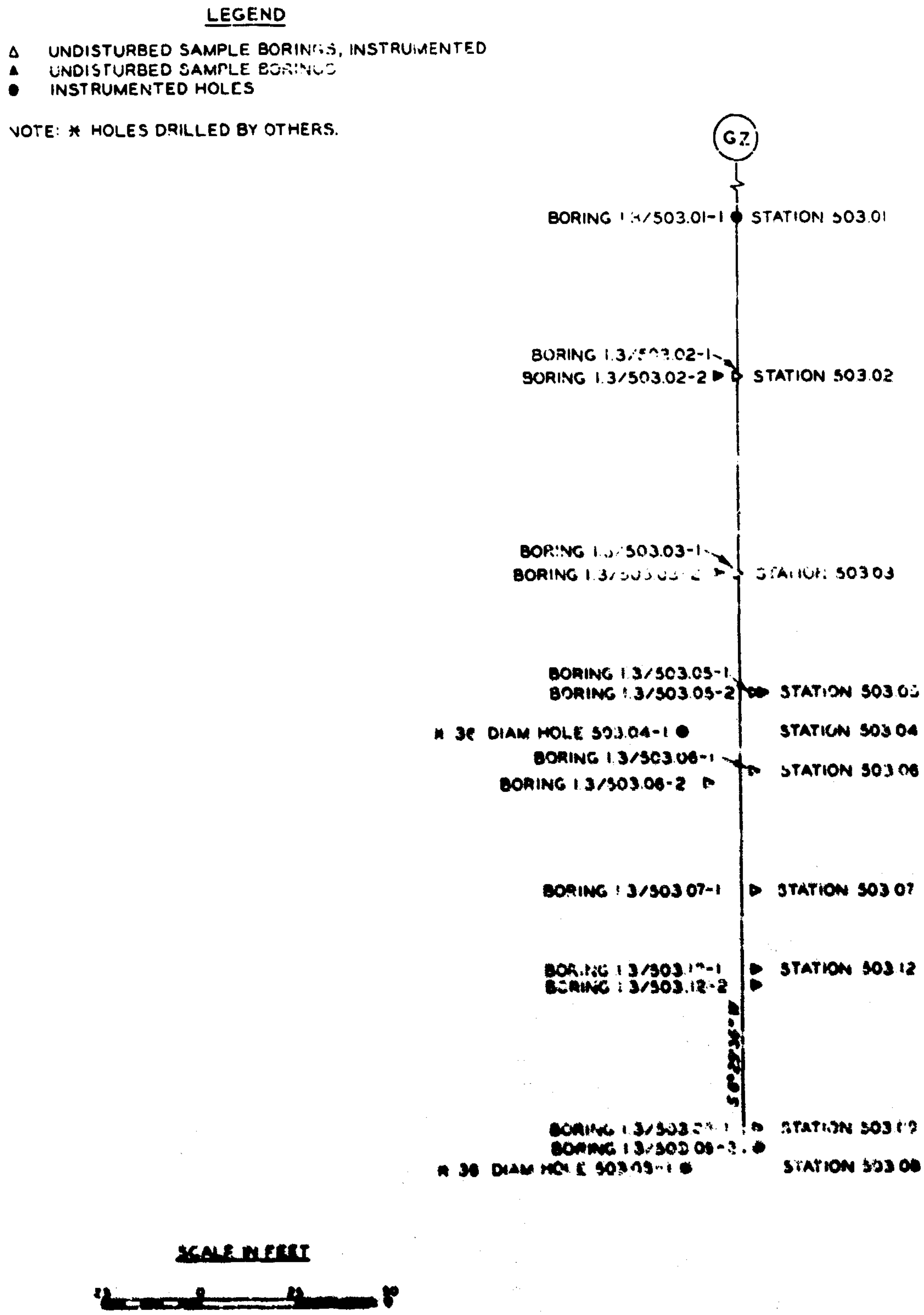


Figure 3.[illegible] Project 1.[illegible] location of borings

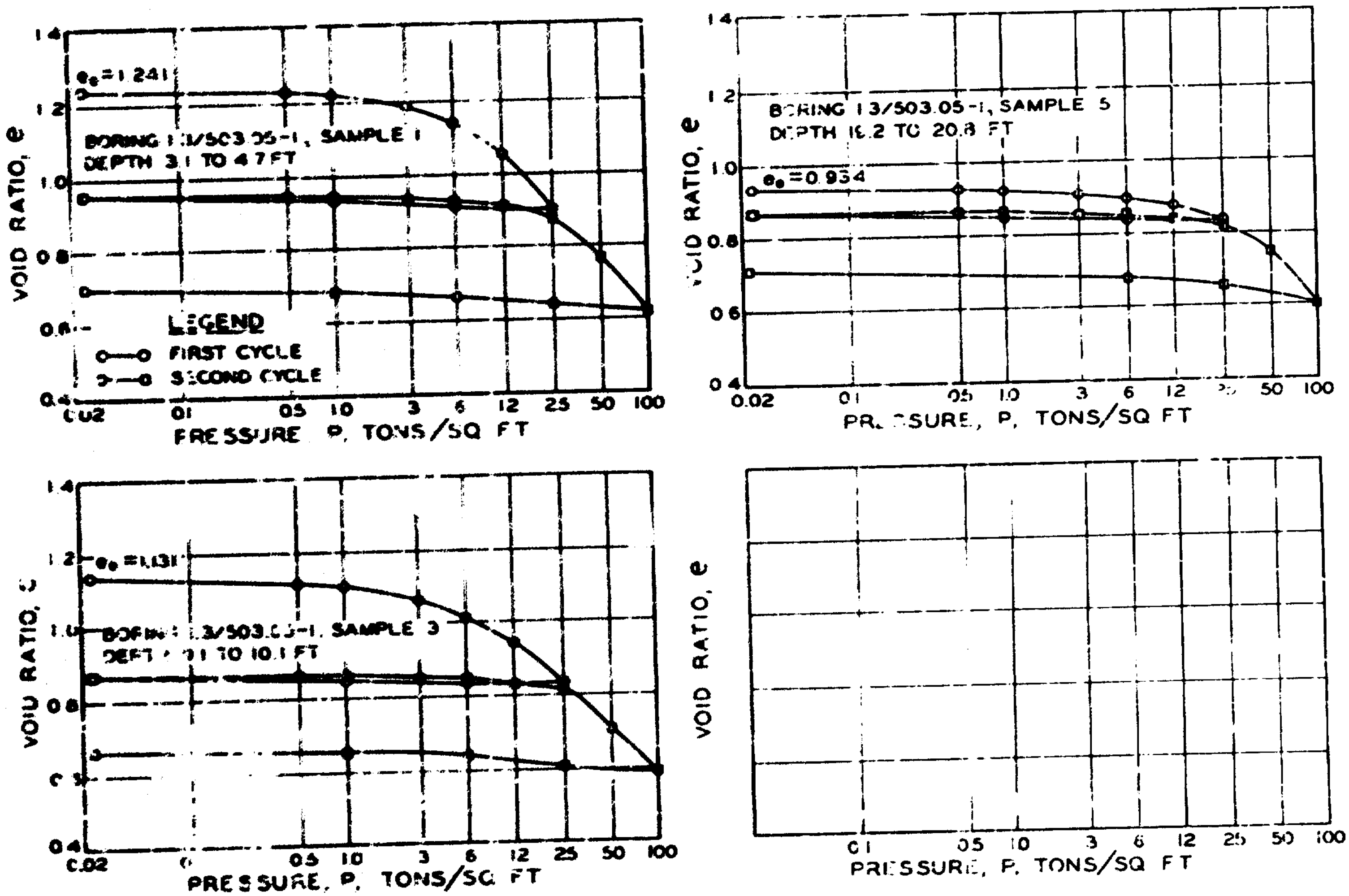
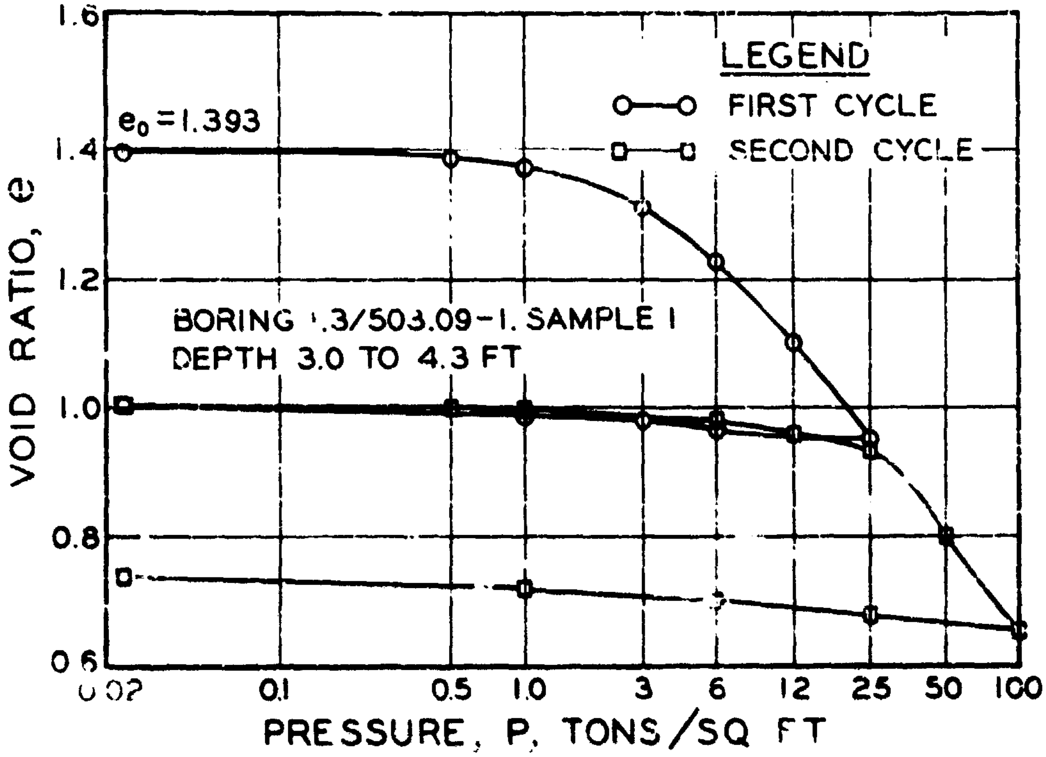


Figure 2.17 Project 1.3, pressure-void ratio (pretest), Samples 1, 3, and 5.



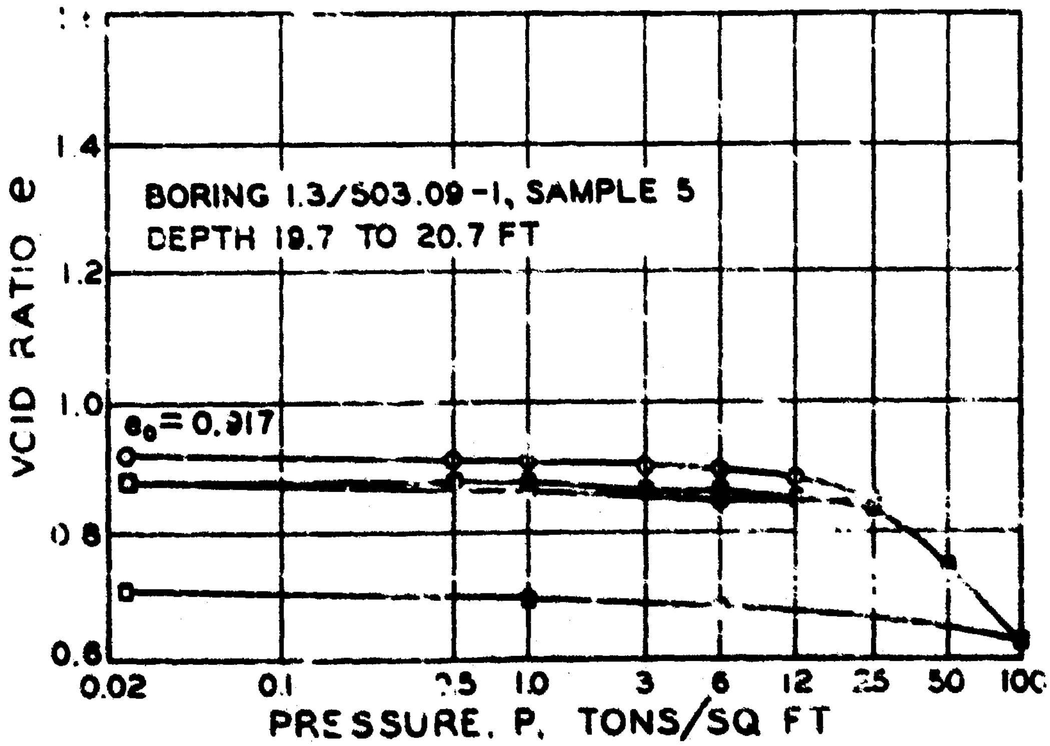


Figure 3.18 Project 1.?, pressure-void ratio (pretest), Samples 1 and 5.

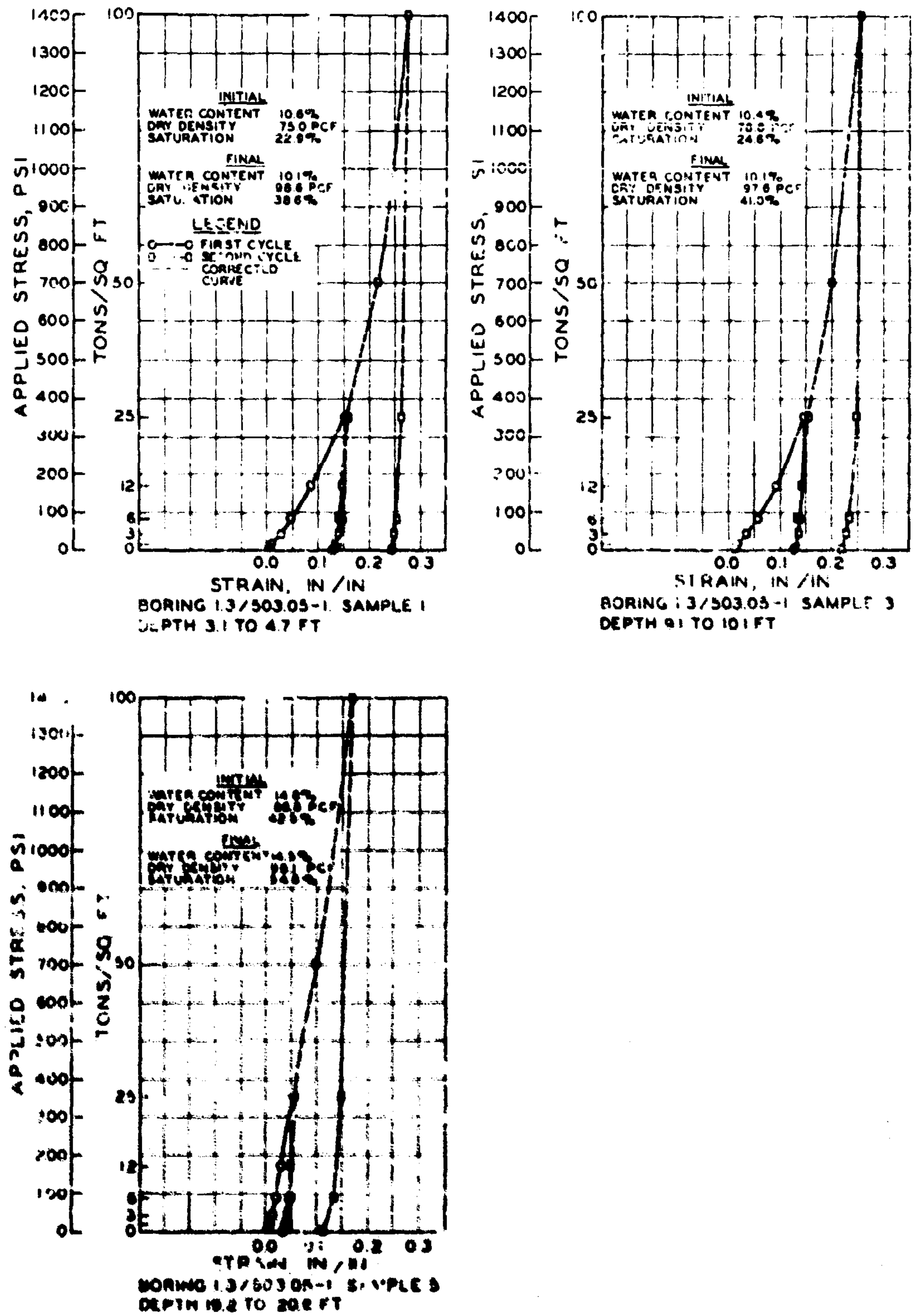


Figure 3.19 Project 1.3, consolidation tests, stress versus strain (pretest), Samples 1, 3, and 5.

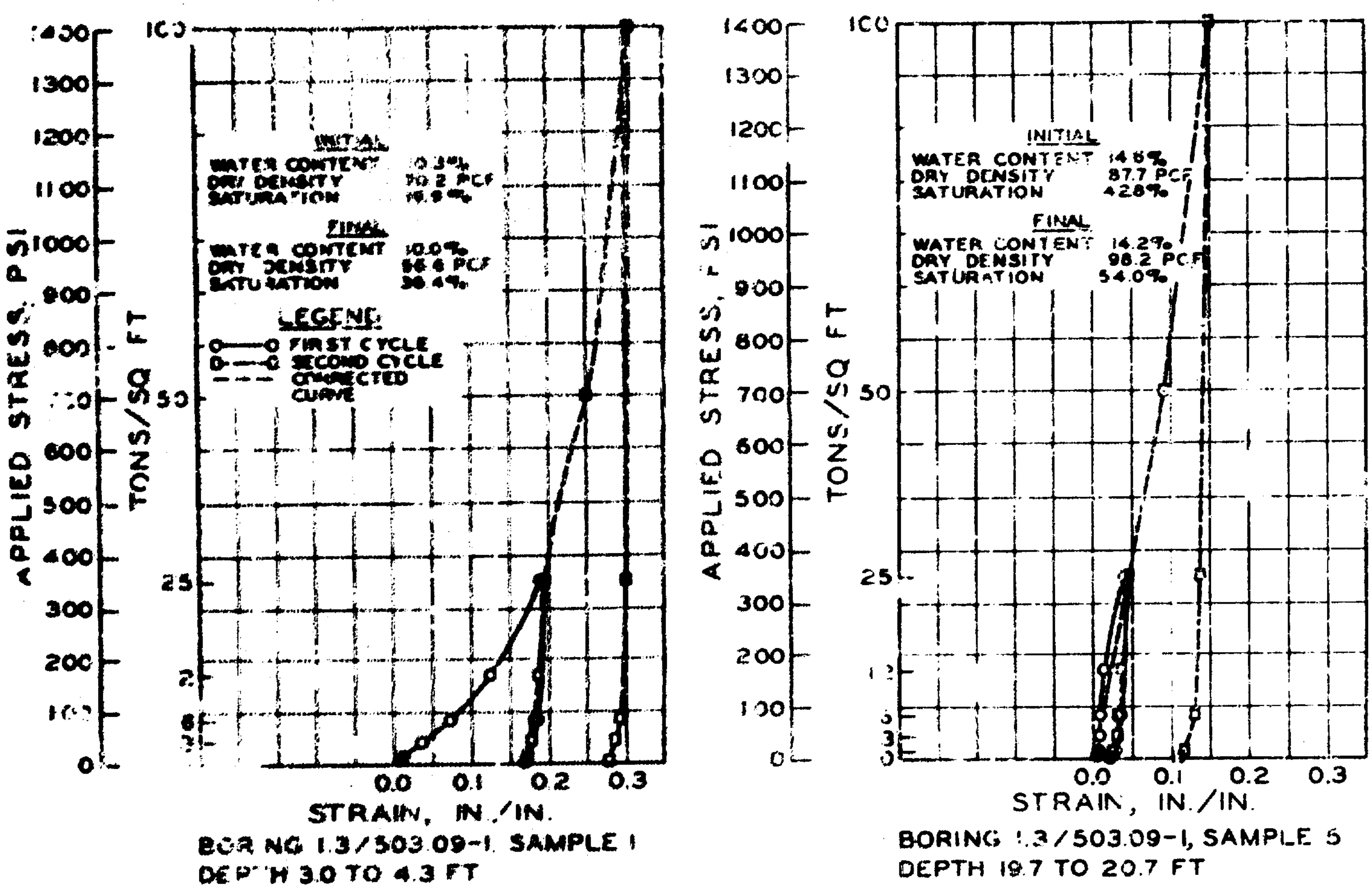
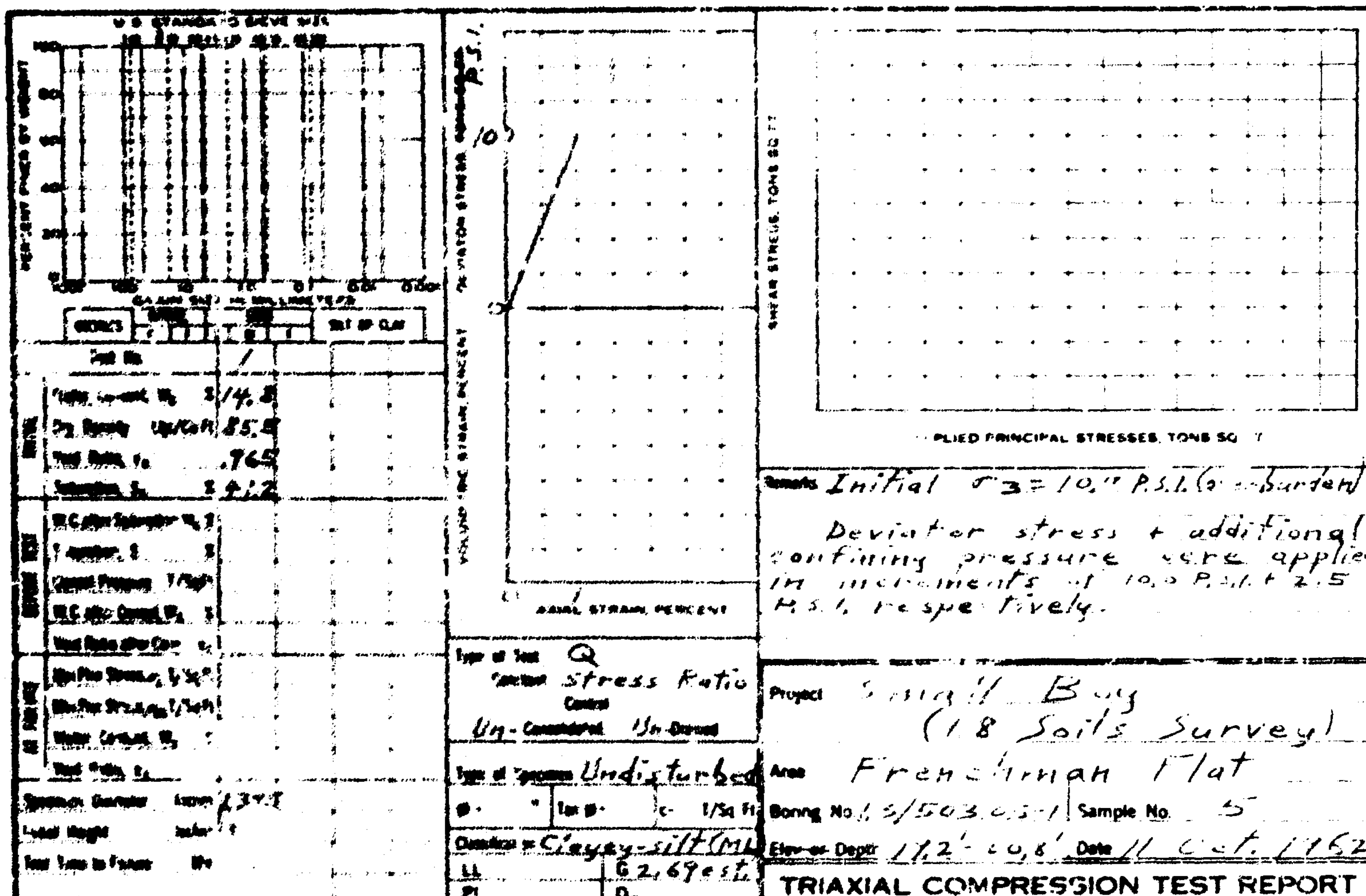


Figure 3.26 Project 1.3, consolidation tests, stress versus strain (pretest), Samples 1 and 5.



TRIAXIAL COMPRESSION TEST REPORT

Remarks: Initial σ_3 = 10.0 P.S.I. (overburden)

Deviator stress + additional confining pressure were applied in increments of 10.0 P.S.I. + 2.5 P.S.I. respectively.

Project: Small Boy (1.8 Soils Survey)

Area: Frenchman Flat

Boring No.: 1.3/503.03-1 | Sample No.: 5

Elev or Depth: 17.2' - 20.8' | Date: 11 Oct. 1962

Type of Test: Q — Stress Ratio Control; Un-Consolidated, Un-Drained

Type of Specimen: Undisturbed

Classification: Clayey-silt (ML)

G: 2.69 est.

Test No.	1
Water Content, W_o %	14.8
Dry Density, Lb/Cu Ft	85.5
Void Ratio, e_o	.765
Saturation, S_o %	41.2
Specimen Diameter, Inches	1.3??

U.S. STANDARD SIEVE SIZE

PERCENT FINER BY WEIGHT

GRAIN SIZE IN MILLIMETERS

DEVIATOR STRESS, P.S.I.

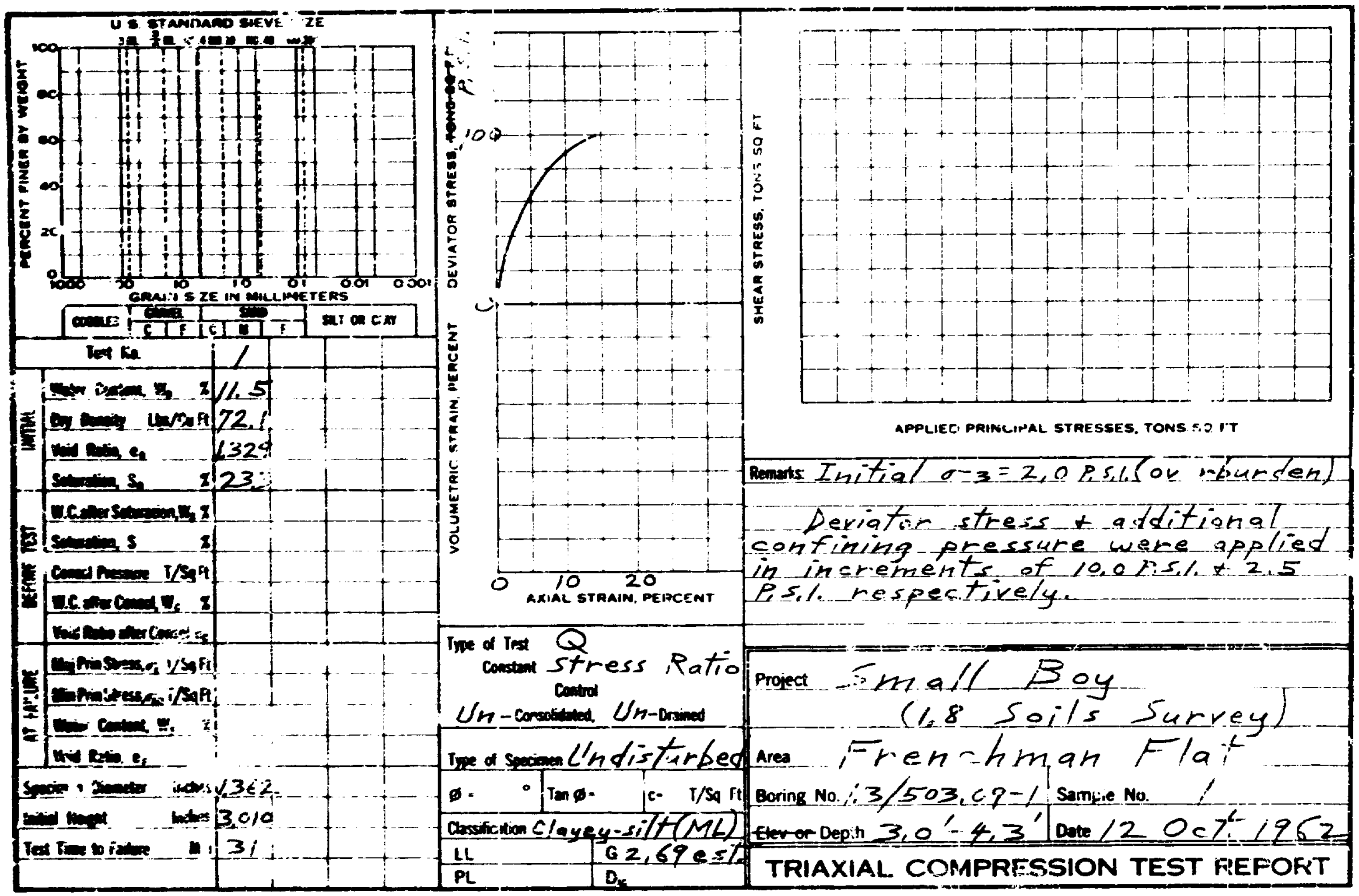
10

AXIAL STRAIN, PERCENT

SHEAR STRESS, TONS SQ FT

APPLIED PRINCIPAL STRESSES, TONS SQ FT

Figure 3.21 Project 1.3, constant-stress ratio triaxial test (pretest) boring 1.3/503.03-1, Sample 5.



TRIAXIAL COMPRESSION TEST REPORT

U S STANDARD SIEVE SIZE

GRAIN SIZE IN MILLIMETERS

PERCENT FINER BY WEIGHT

COBBLES	GRAVEL C	GRAVEL F	SAND C	SAND M	SAND F	SILT OR CLAY

		Test No. 1
INITIAL	Water Content, W_o %	11.5
	Dry Density Lbs/Cu Ft	72.1
	Void Ratio, e_o	1.329
	Saturation, S_o %	23
BEFORE TEST	W.C. after Saturation, W_s %	
	Saturation, S %	
	Consol Pressure T/Sq Ft	
	W.C. after Consol, W_c %	
	Void Ratio after Consol e_c	
AT FAILURE	Maj Prin Stress, σ_1 T/Sq Ft	
	Min Prin Stress, σ_3 T/Sq Ft	
	Water Content, W_f %	
	Void Ratio, e_f	
	Specimen Diameter Inches	1.362
	Initial Height Inches	3.010
	Test Time to Failure Min	31

DEVIATOR STRESS, ~~TONS SQ FT~~ P.S.I.

VOLUMETRIC STRAIN, PERCENT

AXIAL STRAIN, PERCENT

SHEAR STRESS, TONS SQ FT

APPLIED PRINCIPAL STRESSES, TONS SQ FT

Remarks: Initial σ_3 = 2.0 P.S.I. (overburden)

Deviator stress + additional confining pressure were applied in increments of 10.0 P.S.I. + 2.5 P.S.I. respectively.

Type of Test Q

Constant Stress Ratio Control

Un-Consolidated, Un-Drained

Type of Specimen Undisturbed

ϕ - ° Tan ϕ - c- T/Sq Ft

Classification Clayey-silt (ML)

LL

PL

G 2.69 est.

D_o

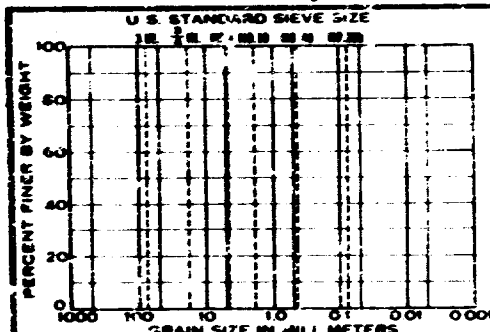
Project Small Boy (1.8 Soils Survey)

Area Frenchman Flat

Boring No. 1.3/503.09-1 Sample No. 1

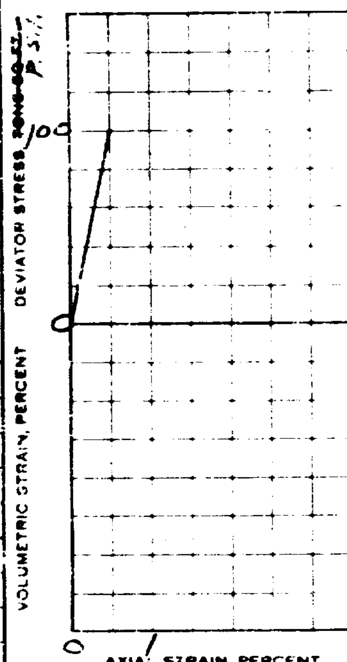
~~Elev or~~ Depth 3.0'-4.3' Date 12 Oct. 1962

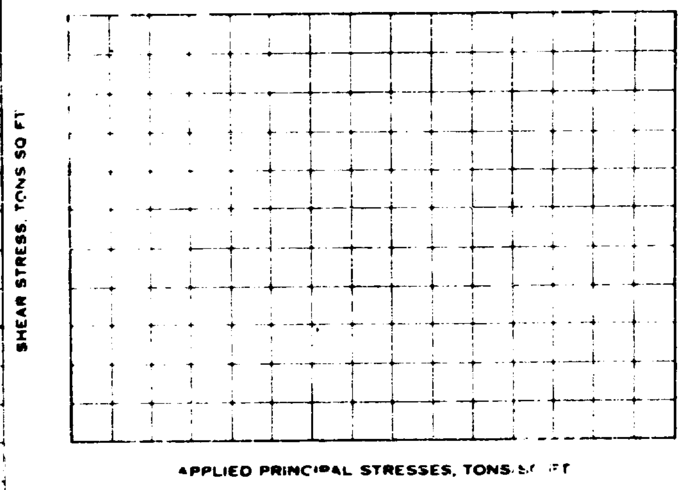
Figure 3.22 Project 1.3, constant-stress ratio triaxial test (pretest), boring 1.3/503.09-1, Sample 1.



COBBLES	GRAVEL C	GRAVEL F	SAND C	SAND M	SAND F	SILT OR CLAY

		Test No.	1		
INITIAL	Water Content, W_o	%	14.9		
	Dry Density	Lbs/Cu Ft	86.2		
	Void Ratio, e_o		.950		
	Saturation, S_o	%	42.3		
BEFORE TEST	W.C. after Saturation, W_s	%			
	Saturation, S	%			
	Consol Pressure	T/SqFt			
	W.C. after Consol, W_c	%			
	Void Ratio after Consol, e_c				
AT FAILURE	Maj Prin Stress, σ_1	T/SqFt			
	Min Prin Stress, σ_3	T/SqFt			
	Water Content, W_f	%			
	Void Ratio, e_f				
Specimen Diameter		inches	1.375		
Initial Height		inches	3.010		
Test Time to Failure		Min	28		





Remarks: Initial σ_3 = 10.7 P.S.I. (overburden)
Deviator stress + additional confining pressure were applied in increments of 10.0 P.S.I. + 2.5 P.S.I. respectively.

Type of Test: Q
Constant Stress Ratio Control
Un-Consolidated, Un-Drained

Type of Specimen: Undisturbed

ϕ = °	Tan ϕ =	c = T/Sq Ft

Classification: Clayey-silt (ML)

LL		G	2.69 est.
PL		D_e	

Project: Small Boy (1.8 Soils Surv. 1)
Area: Frenchman Flat
Boring No. 1.3/503.09-1 Sample No. 5
~~Elev or~~ Depth 19.7'-20.7' Date 12 Oct. 1962

TRIAXIAL COMPRESSION TEST REPORT

Figure 3.23 Project 1.3, constant-stress ratio triaxial test (pretest), boring 1.3/503.09-1, Sample 5.

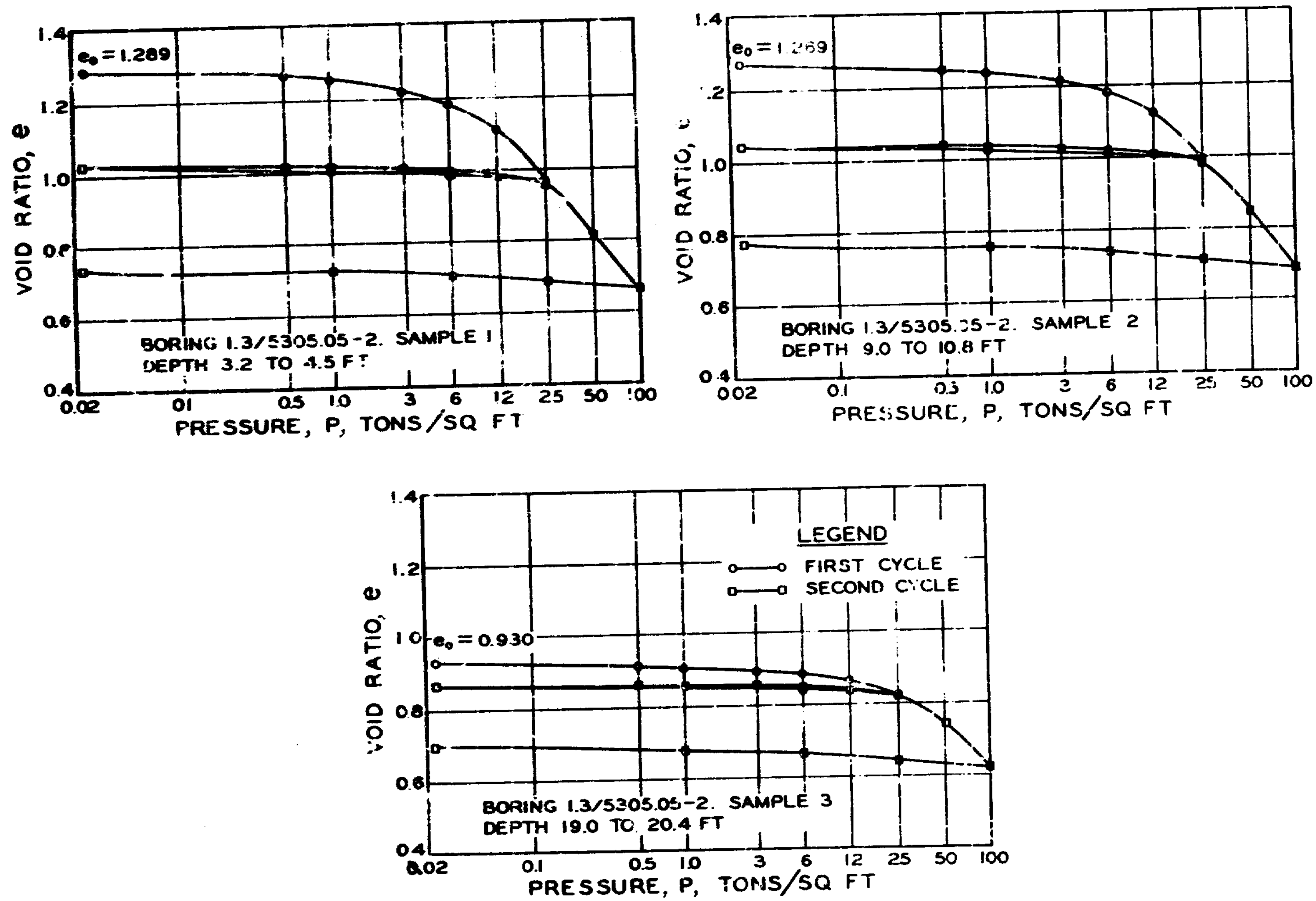


Figure 3.24 Project 1.3, pressure-void ratio (posttest).

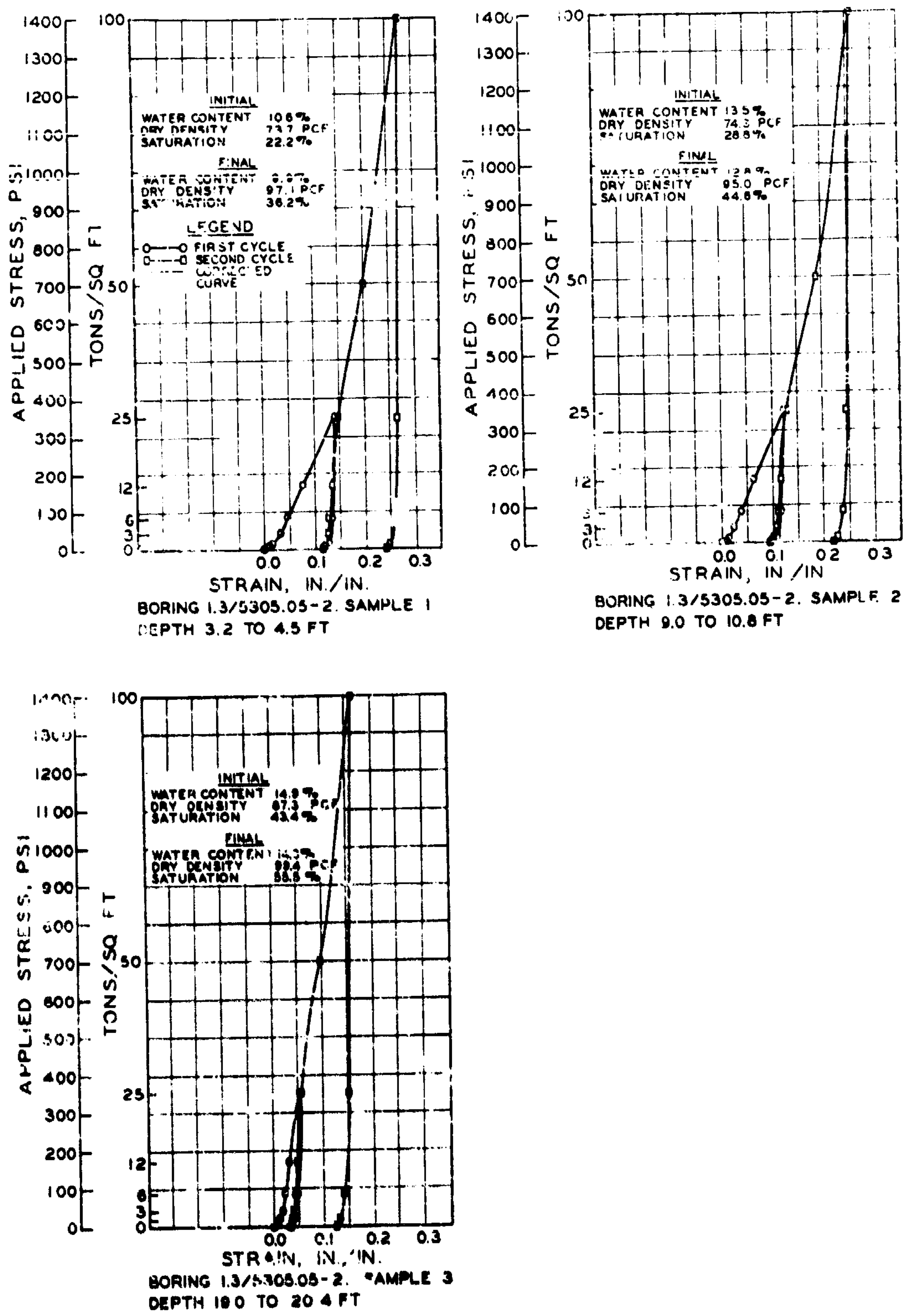
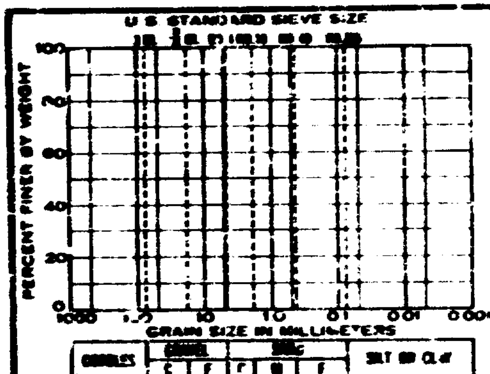
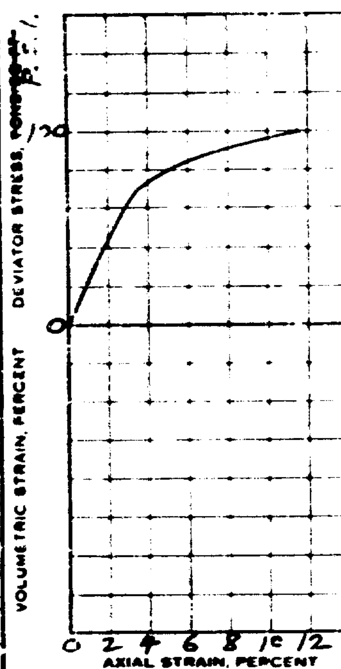
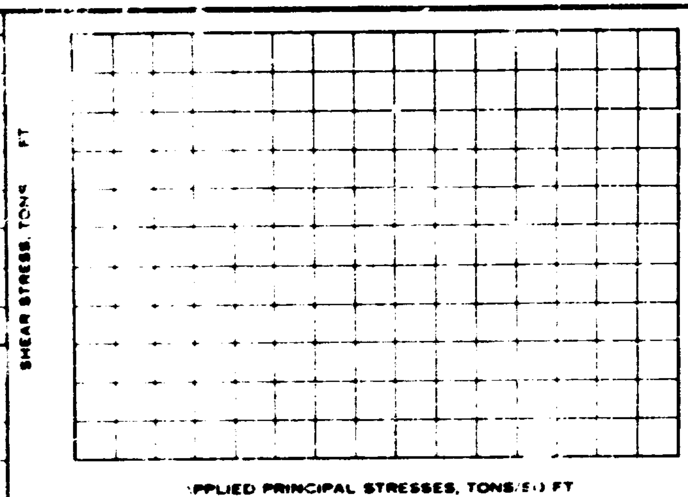


Figure 3.25 Project 1.3, consolidation tests, stress versus strain (posttest).



Test No.	1			
INITIAL — Water Content, W_o %	12.7			
Dry Density Lbs/Cu Ft	75.4			
Void Ratio, e_o	1.227			
Saturation, S_o %	27.9			
BEFORE TEST — W.C. after Saturation, W_s %				
Saturation, S %				
Consol Pressure T/Sq Ft				
W.C. after Consol, W_c %				
Void Ratio after Consol, e_c				
AT FAILURE — Maj Prin Stress, σ_1 T/Sq Ft				
Min Prin Stress, σ_3 T/Sq Ft				
Water Content, W_f				
Void Ratio, e_f				
Specimen Diameter inches	1.424			
Initial Height inches	2.933			
Test Time to Failure Hr.	25			





Type of Test: Q — Constant Stress Ratio Control — Un-Consolidated, Un-Drained

Type of Specimen: Undisturbed

ϕ - ° | Tan ϕ - | c - T/Sq Ft

Classification: Silt (ML)*

LL | G 2.70

PL | D_s

Remarks: * Fan.

Initial σ_3 = 2.4 P.S.I. (overburden)

Deviator stress + additional confining pressure were applied in increments of 10.0 P.S.I. + 2.5 P.S.I. respectively.

Project: Small Boy (1.8 Soils Survey) (Post Shot)

Area: Frenchman Flat

Boring No. 1.3/503.05-2 | Sample No. 1

Elev or Depth 3.2'-4.5' | Date 22 Mar. 1963

TRIAXIAL COMPRESSION TEST REPORT

Figure 3.26 Project 1.3, constant-stress ratio triaxial test (posttest), boring 1.3/503.05-2, Sample 1

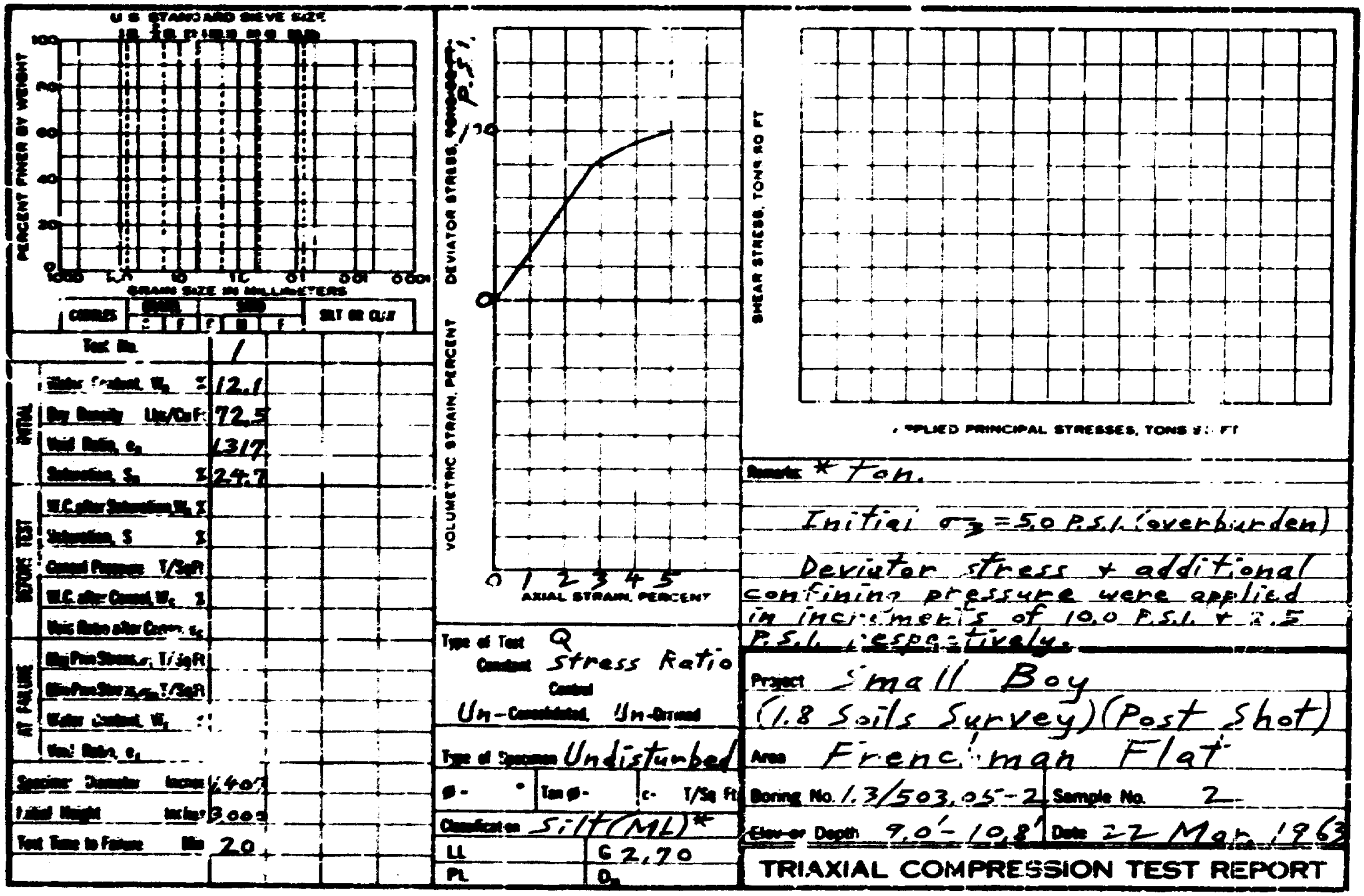
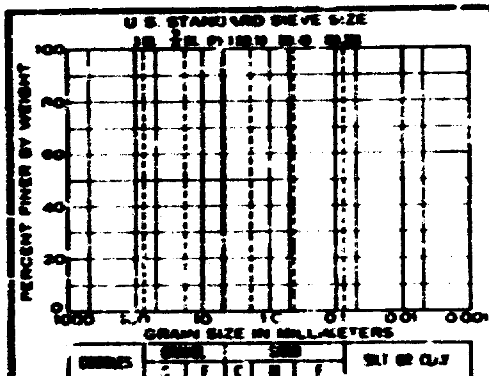
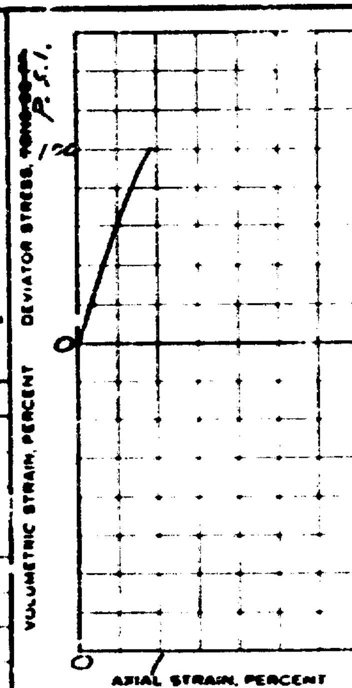
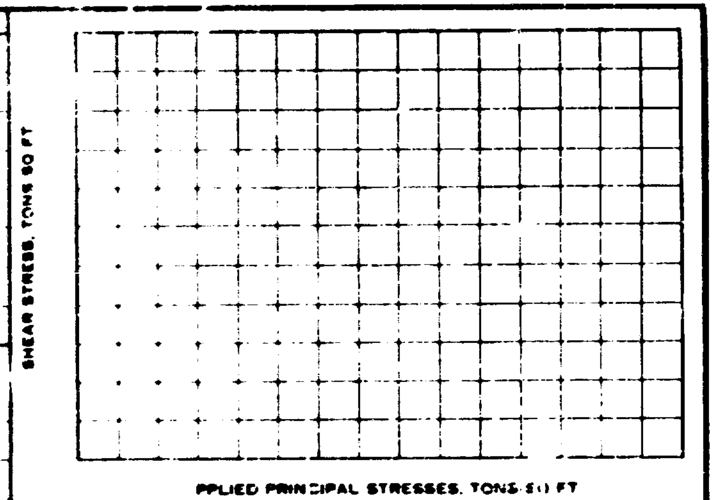


Figure 3.27 Project 1.3, constant-stress ratio triaxial test (posttest), boring 1.3/503.05-2, Sample 2.







	Test No.	1
INITIAL	Water Content, W_o %	15.4
	Dry Density Lbs/Cu Ft	86.1
	Void Ratio, e_o	.951
	Saturation, S_o %	43.4
BEFORE TEST	W.C. after Saturation, W_s %	
	Saturation, S %	
	Consol Pressure T/Sq Ft	
	W.C. after Consol, W_c %	
	Void Ratio after Consol, e_c	
AT FAILURE	Max Prin Stress T/Sq Ft	
	Min Prin Stress T/Sq Ft	
	Water Content, W_f %	
	Void Ratio, e_f	
	Specimen Diameter Inches	1.420
	Initial Height Inches	3.010
	Test Time to Failure Min	19

Type of Test: Q
Constant Stress Ratio Control
Un-Consolidated, Un-Drained
Type of Specimen: Undisturbed
ϕ - ° Tan ϕ - c - T/Sq Ft
Classification: Silt (ML) *
LL 35 G 2.70
PL 26 $D_{[illegible]}$

Remarks: * Tan.

Initial σ_3 = 10.7 P.S.I. (overburden)

Deviator stress + additional confining pressure were applied in increments of 10.0 P.S.I. + 2.5 P.S.I. respectively.

Project: Small Boy (1.8 Soils Survey) (Post Shot)
Area: Frenchman Flat
Boring No. 1.3/503.05-2 Sample No. 3
Elev or Depth 19.0'-20.4' Date 22 Mar. 1963

TRIAXIAL COMPRESSION TEST REPORT

Figure 3.28 Project 1.3, constant-stress ratio triaxial test (posttest), boring 1.3/503.05-2, Sample 3.

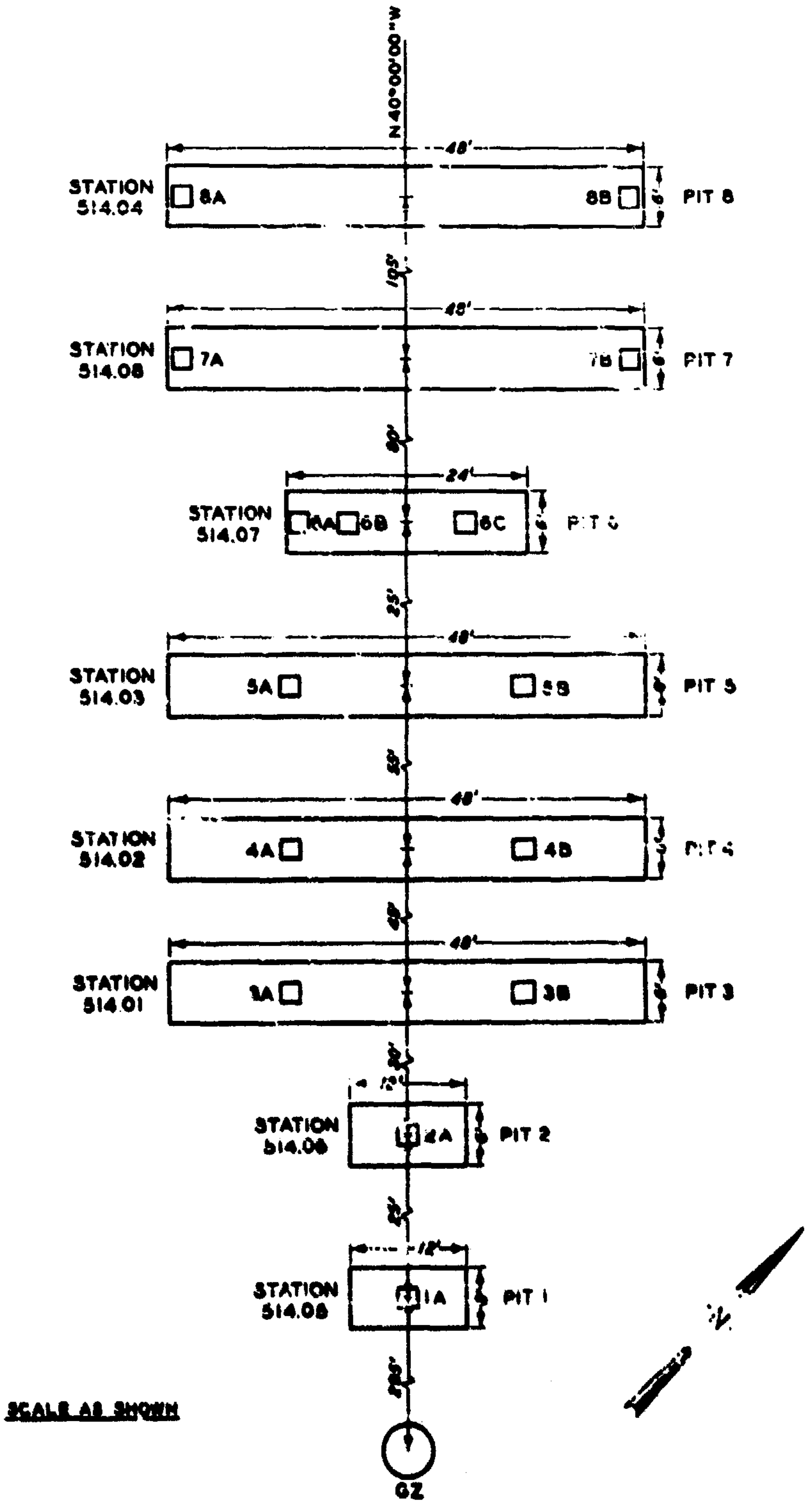


Figure 3.39 Project 3.1, location of field density tests.

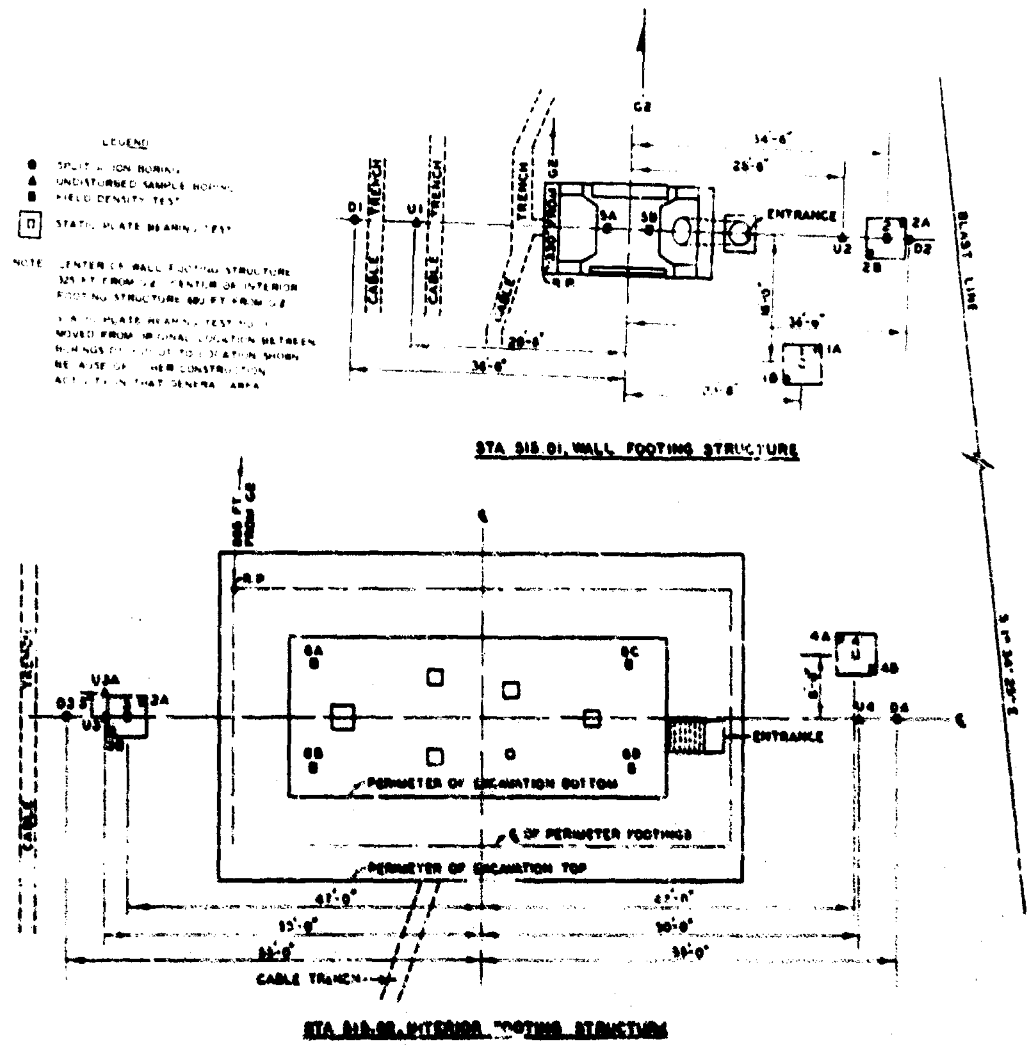
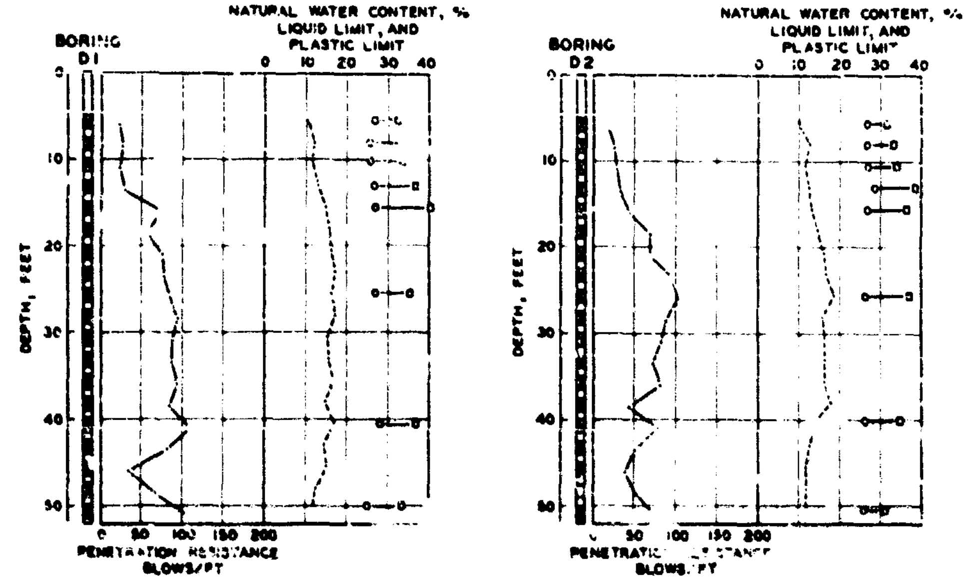
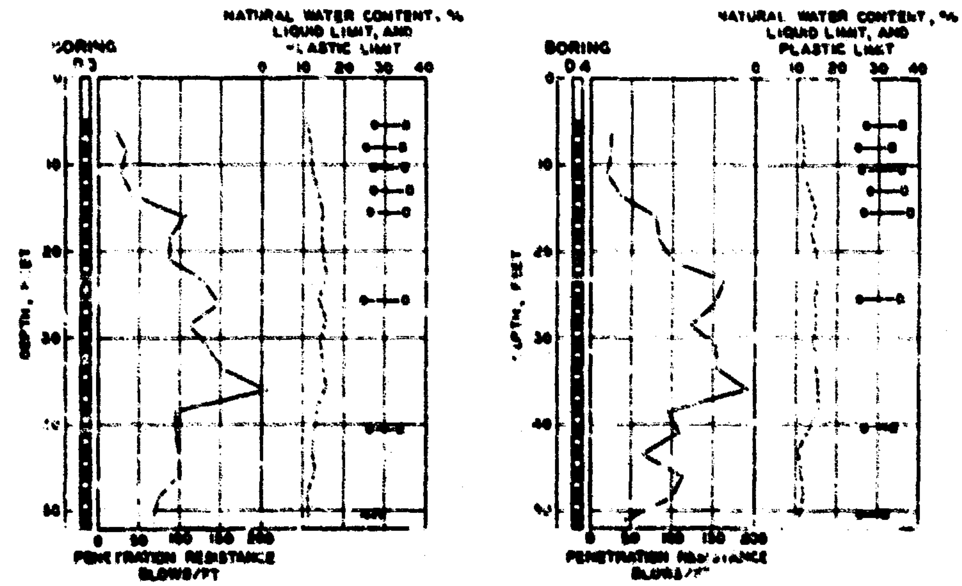


Figure 3.30 Project 3.2, plan of borings, density tests, and plate bearing tests.



STA 515.01
WALL FOOTING STRUCTURE



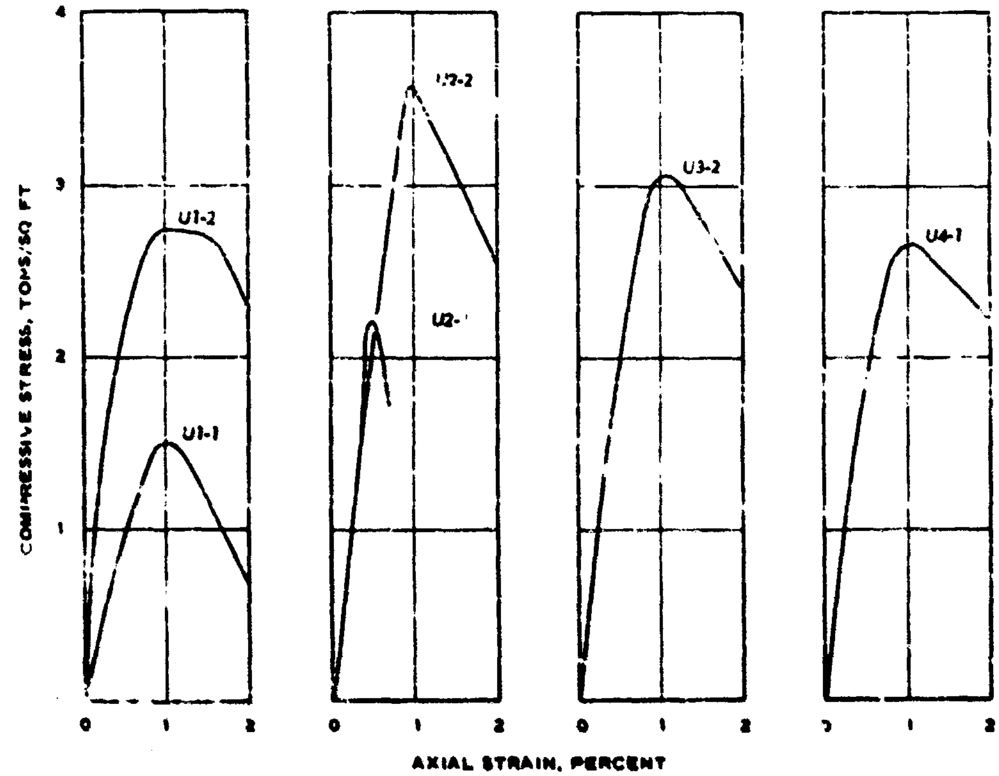
STA 515.02
INTERIOR FOOTING STRUCTURE

LEGEND

- PENETRATION TEST AND SPLIT SPOON SAMPLE
- PENETRATION RESISTANCE, BLOWS/FT
- NATURAL WATER CONTENT, %
- PLASTIC LIMIT
- LIQUID LIMIT

SEE FIG 3.38 FOR LOCATION OF BORINGS

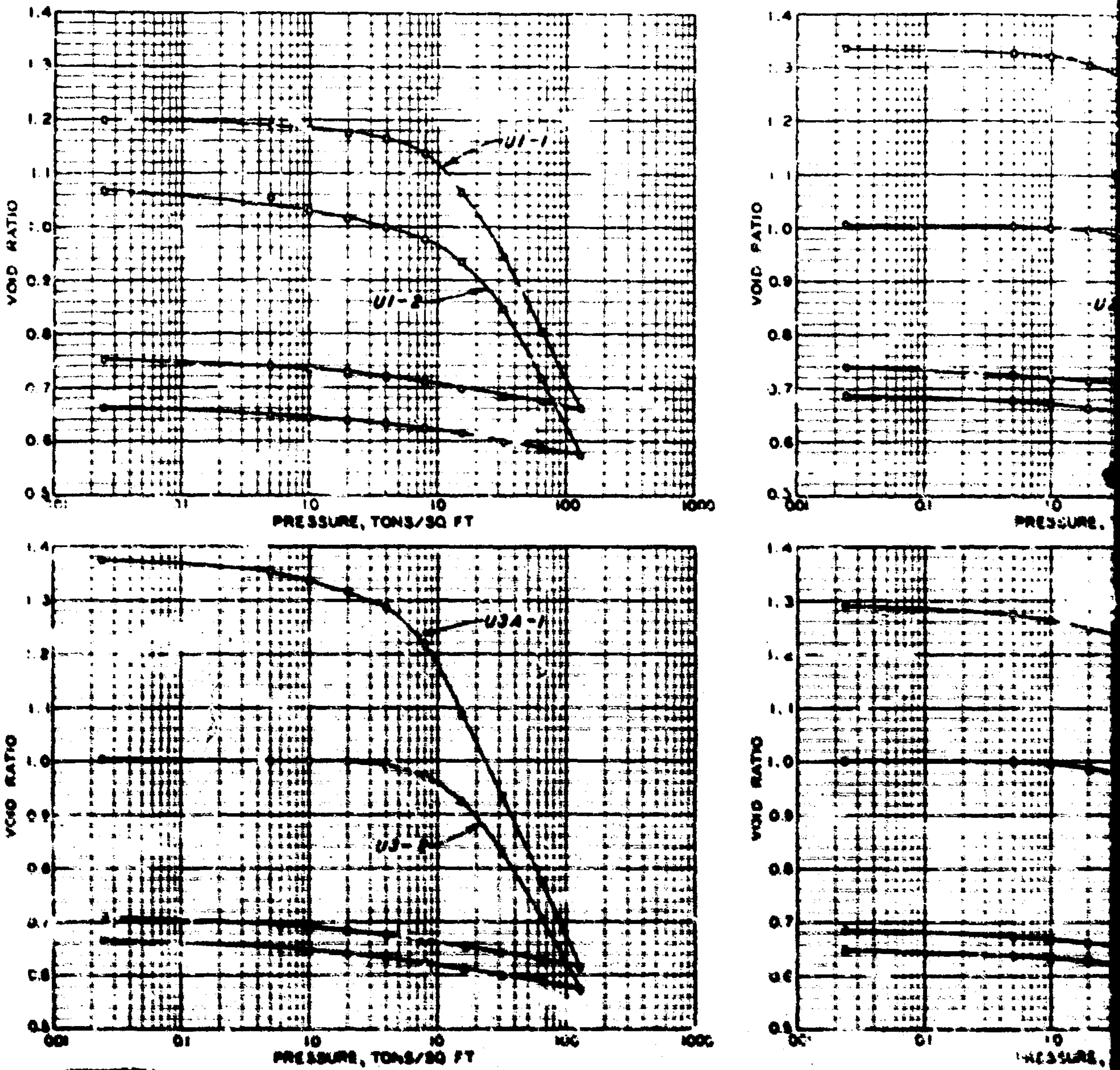
Figure 3.?? Project 3.3, results of split spoon boring tests.



SAMPLE NO.[1]		U1-1	U1-2	U2-1	U2-2	U3-2	U4-1
INITIAL	DIAMETER, IN.	2.83	2.76	2.73	2.86	2.77	2.78
	HEIGHT, IN.	5.38	5.82	6.18	[illegible]	6.04	5.94
NATURAL	WATER CONTENT, %	10.3	14.6	11.6	13.5	13.2	11.9
	VOID RATIO	1.36	1.12	[illegible]	1.08	0.98	1.08
	SATURATION, %	20.5	35.4	23.7	36.8	35.4	29.7
	DRY DENSITY, PCF	71.7	78.8	[illegible]	83.7	85.3	81.2
TIME TO FAILURE, MINUTES		1.5	1.0	1.0	1.0	1.0	1.0
UNCONFINED COMPRESSIVE STRENGTH, TONS/SQ FT		1.55	2.75	2.21	[illegible]	3.07	2.66
SHEAR STRENGTH, TONS/SQ FT		0.78	1.37	1.10	[illegible]	1.53	[illegible]

(1) SEE FIG. 3.30 AND TABLE 3.9 FOR LOCATION AND DEPTH OF SAMPLES.

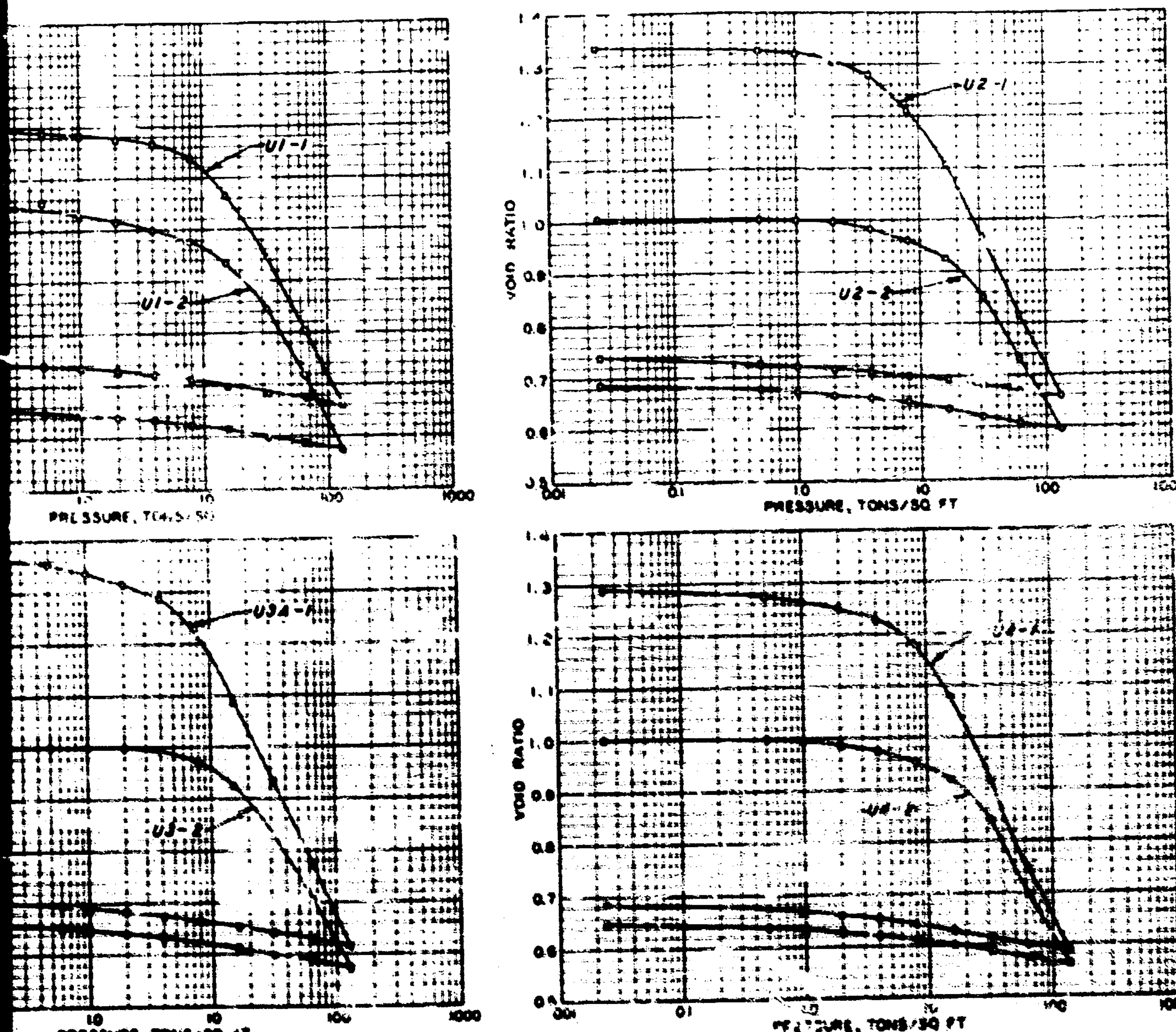
Figure 3.32 Project 3.2, results of laboratory unconfined compression tests.



SAMPLE NUMBER		U1-1	U1-2	U2-1	U2-2	U3A-1	U3-2	[illegible]	U4-2
INITIAL	WATER CONTENT, %	14.6	14.6	8.0	13.8	9.9	14.2	[illegible]	13.6
	VOID RATIO	1.20	1.07	1.33	[illegible]	1.37	[illegible]	[illegible]	1.00
	SATURATION, %	32.9	37.9	16.8	36.5	19.4	37.7	29.9	38.0
	DRY DENSITY, PCF	76.9	81.7	72.4	82.8	71.2	82.8	73.9	83.0
FINAL	WATER CONTENT, %	14.2	14.3	7.6	13.5	8.0	14.1	13.9	13.4
	VOID RATIO	0.75	0.67	0.74	0.60	0.71	[illegible]	[illegible]	[illegible]

NOTE: ALL SPE[illegible] 0.75 IN. [illegible] IN DIAME[illegible] SEE FIG [illegible] LOCATION[illegible]

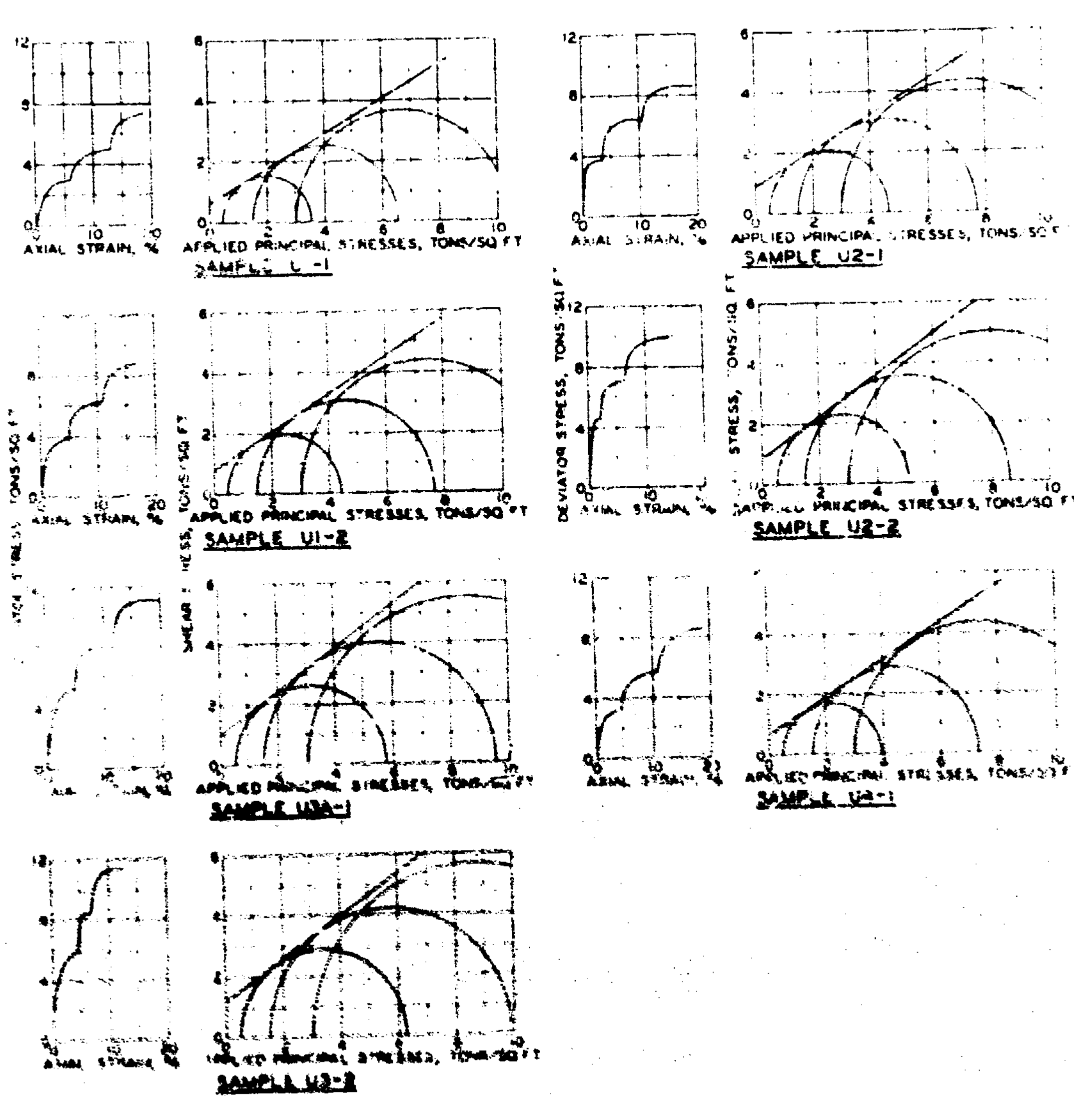
Figure 3.33 Project 3.[illegible], results of laboratory consolidation tests.



	SAMPLE NUMBER	U1-1	U1-2	2-1	U2-2	U3A-1	U3-2	U4-1	U4-2
INITIAL	WATER CONTENT, %	14.6	14.[illegible]	8.0	13.6	9.9	14.3	14.1	13.6
	VOID RATIO	1.20	1.07	1.20	1.01	1.27	1.01	1.29	1.00
	SATURATION, %	32.9	37.5	[illegible]	36.9	19.4	37.2	29.5	36.8
	DRY DENSITY, PCF	76.9	81.7	72.4	82.0	[illegible]	82.0	73.9	82.0
FINAL	WATER CONTENT, %	14.2	14.3	7.6	13.5	9.0	14.1	12.9	13.4
	VOID RATIO	0.75	0.67	0.74	0.66	0.71	0.67	0.60	0.59

NOTE: ALL SPECIMENS WERE 0.75 IN. HIGH AND 2.50 IN. IN DIAMETER.
SEE FIG. 30 AND [illegible] 3.3 FOR LOCATION AND DEPTH OF SAMPLES.

Project 3.2, results o. laboratory consolidation tests.



SAMPLE NUMBER	U1-1	U1-2	U2-1	U2-2	U3A	U3-2	[illegible]
DIAMETER, IN	2.82	2.16	[illegible]	2.96	2.78	2.78	2.78
HEIGHT, IN	[illegible]	6.24	6.02	5.90	5.90	6.27	[illegible]
WATER CONTENT, %	11.8	12.9	[illegible]	12.2	[illegible]	13.4	13.9
VOID RATIO	[illegible]	[illegible]	1.27	[illegible]	[illegible]	1.06	[illegible]
SATURATION, %	24.1	26.2	25.6	28.9	[illegible]	[illegible]	[illegible]
DRY DENSITY, PCF	70.1	75.6	76.1	[illegible]	[illegible]	[illegible]	[illegible]
LATERAL PRESSURE, TONS/SQ FT	0.5 1.5 3.0	0.5 1.5 3.0	0.5 1.5 3.0	0.5 [illegible]	[illegible]	0.5 1.5 3.0	0.5 1.5 3.0
MAJOR PRINCIPAL STRESS, TONS/SQ FT	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
MINOR PRINCIPAL STRESS, TONS/SQ FT	0.5 1.5 3.0	0.5 1.5 1.0	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
TEST TIME TO FAILURE (ACCUM) MINUTES	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
ANGLE OF SHEARING RESISTANCE, DEGREES	[illegible]	32	30	[illegible]	30	[illegible]	32
COHESION, C, TONS/SQ FT	0.6	0.6	1.0	0.9	1.0	[illegible]	0.7

NOTE: SEE FIG [illegible] AND TABLE [illegible] FOR LOCATION AND DEPTH OF SAMPLES

Figure 3.34 Project [illegible], results of multiple-stage triaxial tests.

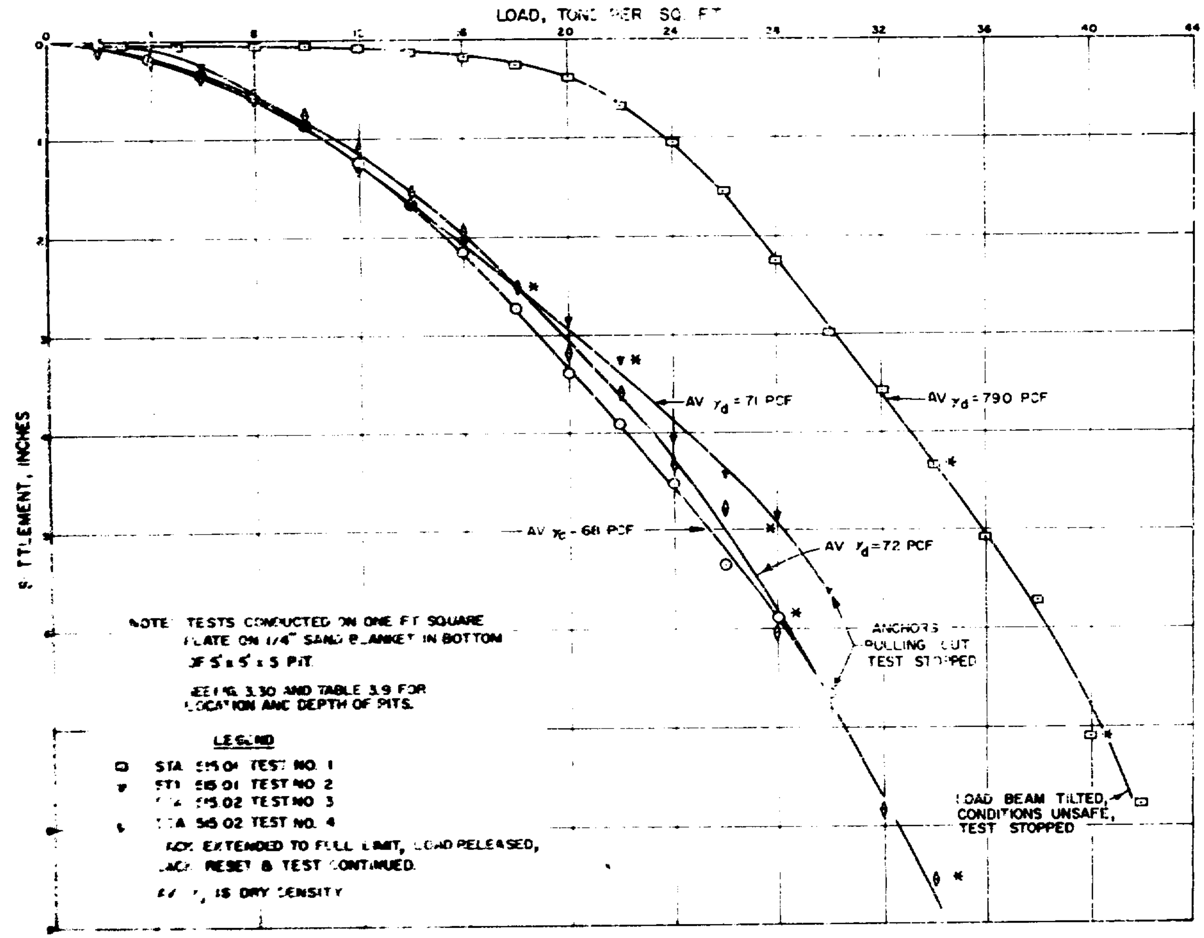


Figure 3.35 Project 3.2, results of static load bearing tests.

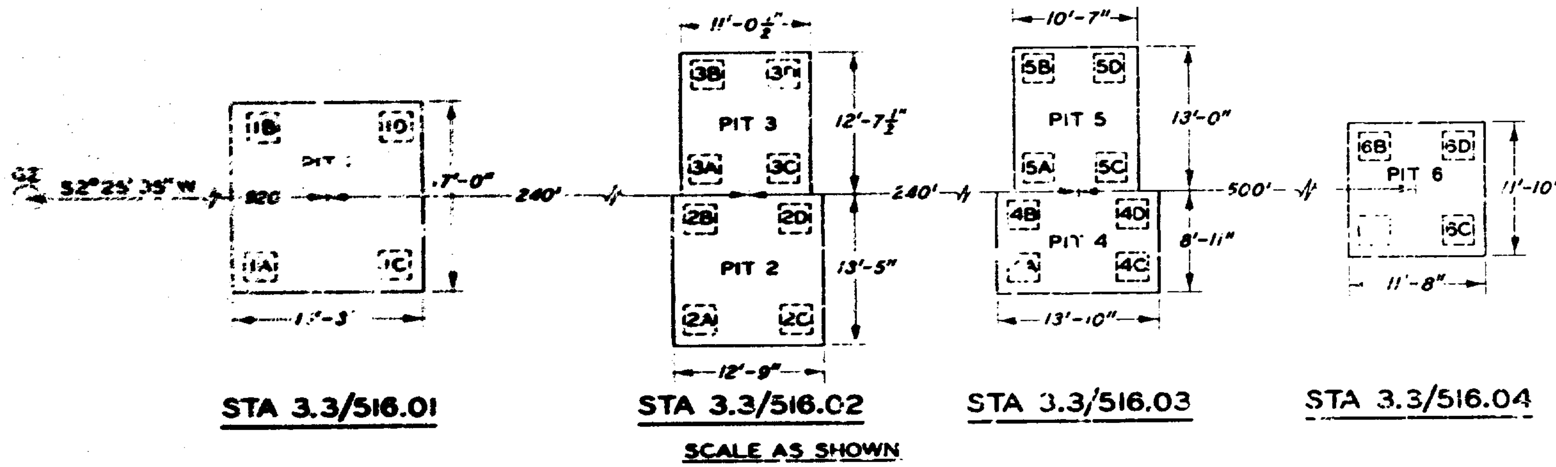


Figure 3.36 Project 3.3, location of field density tests.

REFERENCES

1. "The Unified Soil Classification System"; Corps of Engineers, U. S. Army, TM 3-357, March 1953; U. S. Army Engineer Waterways Experiment Station, Vicksburg, Mississippi (UNCLASSIFIED)

2. Lambe, T. W.; "Soils Testing for Engineers," First Edition, 1951, John Wiley & Sons, Inc., New York, New York, and Chapman & Hall, Limited, London, England (UNCLASSIFIED)

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